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The Ceylon Rubber Exhibition.

Speaking generally, the Rubber Exhibition may be called an unqualified success, and we have learnt many lessons from it, which should indirectly repay its cost many times over. To take only a few of these, we may assume for example that the days of the biscuits are numbered. This was the original form in which Mr. Parkin made up his samples in the laboratory, and has survived in Ceylon, though abandoned in Malaya. No one who saw the businesslike appearance of the Malayan and other samples of block and sheet as compared with the amateur look of the biscuits can doubt that the latter are doomed to disappearance.

We have also learnt that the area available for rubber-planting is more extended, both as to altitude and as to extension, than had hitherto been supposed, and that there will soon be some danger of over-production, as planting is going on so rapidly, not only in Ceylon and the Federated Malay States, but in other tropical countries.

As regards methods of preparation, there is evidently much yet to learn, and experiments will at once be put in hand by the Botanical Department on several lines suggested by the Exhibition. For instance, is it really the case, as the awards of prizes would at first glance suggest, that high-grown rubber is better than that of the low country, or is it that the prize winners have older trees or have adopted more careful methods of preparation? In one case at least, and that the best Para rubber in the Exhibition, the rubber was coagulated with a chemical not hitherto used, so far as we know, by any one else for the purpose.

The tapping knives for Para rubber were very good, but for Castilloa, and still more for Ceara, were but poor, little ingenuity being shown in adapting them to the changed conditions.

Another important question is "do we wash and dry our rubber too much?" The Malayan rubbers were mostly more washed than those of Ceylon, and were on the whole inferior to them in quality, and there was other evidence pointing the same way. The South American rubbers exhibited are much stronger than any of the plantation rubbers, and spring back when stretched to a much greater extent, and they are practically unwashed, and, what few if any persons in Ceylon had previously realised, are also undried and quite whitish and opaque. It is consequently quite possible that our rubbers are too much dried. It was specially noticeable

that the block rubber from Lanadron Estate in Johore was particularly springy, and it is possible that the mere blocking of rubber may produce a good effect, as the Lanadron blocks were made from crêpe. The use of creosote, again, as recommended in 1899 by Mr. Parkin, is evidently to be recommended.

It would be well worth while trying an experiment in the production of rubber for market by preparing creosoted biscuits, and blocking them while still damp or partially dried. If for rubber containing a proportion of moisture we could obtain a price even approaching that now paid for biscuits, it would pay us well. Very few people realise that fine Para really gets a better price than plantation. If the price of plantation rubber be 6*s.* 3*d.*, while that of fine Para is 5*s.* 8*d.* then, as the latter contains 18 per cent of moisture, its price is really better than that of the plantation rubber in the proportion of 83 to 76, or nearly 10 per cent.

It is evident that now is the time to try experiments in methods of coagulation, ways of preparation, forms or shapes of preparation, ways of packing, and many other things, before the London market has become firmly wedded to one particular mode. Many planters think that the biscuit is good enough, but this obviously cannot last, and now is the time to experiment.

With regard to pests of rubber, again, one simple lesson, among others, that we have learnt is that each estate should keep a supply of apparatus and materials for dealing with them, and not have to hastily borrow at a time of need, or find them unprocurable. Belts of shelter trees again should be left or planted through large areas of rubber.

The machinery, while giving promise of great things in the future, was in general not very good, and capable of much improvement.

In reference to the future of rubber, one of the most interesting and important exhibits of the whole show is that of Mr. Bamber, illustrating his methods of vulcanising and colouring rubber in the milk. This probably means the ultimate extinction of present methods of vulcanising and colouring (except for wild rubbers) and opens up many new lines of work which may prove of great value and importance.

GUMS, RESINS, SAPS AND EXUDATIONS.

Rubber Vulcanisation.

By M. Kelway Bamber.

A Lécture delivered at the Ceylon Rubber Exhibition, Royal Botanic Gardens, Peradeniya, on September 18th.

Dr. J. C. Willis, Director, Royal Botanic Gardens, presided at this lecture, and there were also present:—Mrs. J. C. Willis, Mr. and Mrs. Jas. Ryan, Mr. and Mrs. S. P. Jeffery, Mr. and Mrs. W. H. Biddulph, Messrs. R. D. Tipping (S. Coorg), E. S. Campbell (Lanadron Estate, Johore), I. Etherington, A. de Zilva, R. Hugh Pereira, A. M. Fernando, C. J. Bayley, G. Graham Clarke, A. C. Mathew, D. G. Brebner, A. J. Dawson, R. L. Proudlock (Mysore), J. Cameron (Mysore), G. N. Fairhurst, J. P. Ireson, A. W. Greig, G. A. Greig, F. W. de Hoedt, J. B. Carruthers (F.M.S.), P. H. Aste, R. K. Clark, J. H. S. Rogers, H. F. Macmillan, E. Ernest Green, C. O. Macadam, Thos. Petch, J. H. Betts, Dr. A. Lehmann (Mysore), J. Coryton Roberts, Herbert Wright, C. M. Buckworth, Dr. Cuthbert Christy, Mr. A. N. Galbraith, Mrs. H. F. Tomalin, Messrs. Edgar Turner, A. T. Rettie, C. H. E. Zacharias (F.M.S.), C. K. Smithett, H. M. Devitt, C. L. Devitt, C. G. Devitt, G. Bruce Foote, W. A. Horn, W. A. Goodman and several others.

THE LECTURE.

Mr. Bamber, who was received with applause, said:—Ladies and gentlemen, before describing the vulcanisation of rubber it may be advisable to describe the actual latex. Raw caoutchouc may be defined as the thickened or dried-up latex of certain species of plants. Taking the latex of *Hevea Brasiliensis* as typical of most latices, it is as it leaves the tree a white-looking milk-like fluid containing variable quantities of minute globular particles, the diameters of which average 3·5 micro-millimetres, though the range is great. (One micro-millimetre is the one-thousandth part of a millimetre.) The specific weight of latex containing 32 per cent of caoutchouc is 1·018 at 60° Fahr. It is these microscopic globules that constitute the real caoutchouc when caused to agglomerate into a mass, either by drying and smoking, the addition of acids, or certain other chemicals, or by bacterial decomposition of proteid matter, &c., in the latex with production of a free acid causing coagulation somewhat analagous to the curdling of milk. The chemical composition of the fresh latex from mature trees and for the first tappings during more or less dry weather is as follows:—

Caoutchouc	...	...	32·00	per cent.
Nitrogenous matter	...	...	2·03	,,
Mineral ...	...	...	9·07	,,
Resinous ...	...	...	2·03	,,
Water (*faintly alkaline*) ...		...	55·56	,,

I noticed that in the lecture yesterday a question was raised as to

THE AMOUNT OF CAOUTCHOUC IN BRAZILIAN RUBBER,

and I now find from old analyses that Professor Faraday gives it as 37·7 per cent, which is higher than anything we have had here. It is however liable to great variation under different climatic conditions, age of tree, soil and numerous other causes, which it is needless to enumerate here. When latex is coagulated in a vessel by means of acid, the globules do not first rise to the surface like cream and then amalgamate, but coagulation takes place throughout the mass of liquid, the rubber at the moment of formation having the shape of the containing vessel. As soon as coagulation has set in, the rubber instantly acquires its elastic property, and being specifically lighter than water contracts on itself upwards, at first slowly, but with

increasing rapidity, squeezing out from the interior of the mass the bulk of the water and soluble constituents of the latex, until it forms a fairly compact white mass floating on the surface of the clear water. This, when washed, pressed and dried, constitutes rubber and contains 95 to 96 per cent of pure caoutchouc with a specific gravity of ·92 to ·96. Raw rubber so prepared has a characteristic odour, but when produced by the fermentation process and imperfectly washed is highly offensive. It is insoluble in water, but its bulk increases by absorption when immersed in that fluid, and it adds 25 per cent to its weight, while its toughness, adhesiveness and elasticity are greatly reduced. Raw caoutchouc is very elastic at normal temperatures; but if the temperature is reduced to zero, it becomes hard and brittle, but regains its elastic property on being warmed. If heated to 80° Centigrade, or more, it becomes soft and sticky and does not regain its normal properties on being cooled. Exposed for a long time to warm air and light, it becomes less elastic on the surface and more or less sticky or tacky. This condition may also be caused by bacteria or fungi, with probably the production of an oxidising enzyme.

Spiller states that the affected caoutchouc consists of :--

	Affected.	Unaltered Caoutchouc.
Carbon	64·0	85·5
Hydrogen	8·5	12·0
Oxygen	27·5	7·5

Heated to 360°-Fahr. caoutchouc begins to melt, and between 400 and 400°-Fahr. it becomes a dark brown oil. Owing to the above properties of rubber at different temperatures, crude caoutchouc would be of little general use had not the curious reaction of caoutchouc and sulphur known as "vulcanisation" been discovered.

The only uses for raw rubber are the cubes employed by artists, strips for billiard cushions and square cut unvulcanized threads.

The treatment of rubber with either Sulphur or Sulphur Chloride are the only methods at present employed for vulcanisation, though Gerard's process of treating the India-rubber for three hours in a solution of calcium pentasulphide (1·205 sp. gr.) under a pressure of 60 lb. (140° C) yields very satisfactory results. The chief vulcanisers and sulphur-carriers are sulphur, which occurs in two crystalline and one amorphous forms and various metallic sulphides. The chiefly-used commercial varieties are sulphur sticks, flowers of sulphur, milk of sulphur and precipitated sulphur, the latter being undoubtedly the best form of sulphur for vulcanising purposes. It is prepared by the precipitation of sulphur from the solutions of polysulphides with acid, when it separates in an exceedingly fine state of division, and so is capable of more intimate mixture with the Indiarubber. Lead thiosulphate ($Pb\,S_2\,O_3$) and oxide, antimony pentasulphide, ($Sb_2\,S_5$) and zinc sulphide are among the chief sulphur carriers. All the above generally require what is known as *hot* vulcanisation. Chloride of sulphur ($S_2\,Cl_2$.) on the other hand is extensively used for the process of vulcanisation in the cold, but at present can only be employed for vulcanising dry goods, as contact with water causes immediate decomposition. Besides the ordinary sulphuring agents, various colouring matters are frequently incorporated, when the rubber is to be used for decorative or ornamental purposes; but for technical purposes the colour is more or less confined to grey, black and red.

VULCANISING COLOURING INGREDIENTS.

Examples of such colouring ingredients are zinc white, lithopone (Zns. Ba SO_4) and green pigments, golden sulphide ($Sb_2\,S_5$), vermilion, red and brown iron oxides, and various yellows and blues.

Rubber may be looked upon as a colloid body, a class which have a high molecular weight and are non-electrolytic. In colloids only one molecule out of

many is supposed to be capable of acting chemically: hence their great chemical indifference. They have the property of gelatinizing or pectising; but the latter is quite distinct from the former in that it is non-reversible, while the gelatinized state can be reversed by heating or other means. Colloid solutions can be pectised or converted into insoluble colloids at much less concentration than is required for gelatinization; but the influences that induce pectisation are varied. Some colloidal solutions pectise spontaneously on standing, some by boiling and many by freezing, while most inorganic colloids pectise on adding to their solutions minute quantities of electrolytes. The question of the change involved in the pectisation of a colloid is still obscure, but it will probably be ultimately proved to be partly physical, but mostly chemical—the changes in the molecules resulting in the fixation of the relative positions of the colloidal molecules. It is possible that the Brownian movement of the rubber particles, increased by the change in reaction or the addition of an electrolyte, may tend to induce coagulation by increasing the attraction of the various molecules for one another, and by their friction produce amalgamation or cementation. Indiarubber is very sensitive to changes of temperature, becoming soft and sticky or tacky at high temperatures, and hard and brittle at low temperatures, *i.e.*, 10° C. or 50° Fahr. These properties render it quite unsuitable for most economic uses both in hot and cold countries; and had it not been for Goodyear's and Hancock's discoveries regarding the effect of heating mixtures of rubber and sulphur together to a temperature above the melting point of the latter, the demand for rubber would have been very limited. This process is now commonly known as vulcanisation, and consists in the formation of a continuous series of addition products involving the chemical combination of these two substances—polyprene and sulphur. When heated (under pressure or otherwise) to a temperature of 120° C. or over (the melting point of sulphur being 113·5° C.) the resulting addition compound is a polyprene sulphide of the probable formula ($C_{100}H_{160}S$) for soft goods and ($C_{10}H_{16}S_2$) for ebonite, the highest vulcanised product. The rate at which sulphur enters into combination with the Indiarubber hydrocarbon "polyprene" ($C_{10}H_{16}$) varies with each brand of rubber and the temperature and time employed in the vulcanisation, but in most instances there is a steady increase corresponding with the higher temperature and longer period employed, and in the finished product a gradual reduction in elasticity with increase of hardness.

METHODS OF VULCANISING.

In the ordinary vulcanisation there is only from 2 to 2·5% of combined sulphur, but a much larger proportion is usually added in the mixing, and some of this uncombined sulphur frequently appears on the surface of rubber goods in the form of a fine efflorescence. There are three or four methods by which this is accomplished. The first is to introduce the articles into a boiler, and after closing the end hermetically to admit steam from another boiler until the pressure amounts to 52 or 60 lb. per sq. inch, corresponding to a temperature of 142° C. to 144° C. The length of time this has to be maintained depends on the quality of the rubber, Para vulcanising more slowly than the soft and more sticky varieties; it also depends on the cross-action of the rubber to be vulcanised—thin objects being completed within the first hour, and thicker objects requiring two to three hours.

The boilers employed for this purpose are frequently of enormous size, the largest being about 65 feet long by 16 feet to 20 feet in diameter. They are constructed of strong wrought iron in a similar manner to an ordinary steam boiler except that one end is removable for putting in on a tramway the trays or trollies on which the various articles are placed. The object of the great length is to vulcanise tubes in a straight line, and so preserve their shape, the tube being mounted on an iron mandrel, the diameter of which corresponds to the inner bore.

Toys and other small objects are vulcanised in moulds, hollow articles usually having a little water or ammonia placed inside them in the mould, so that when heated the elastic force of the vapour compresses the rubber against the walls of the mould. Another method of vulcanising employed for flat objects such as shoe-soles, belting sheet, &c., is by the employment of screw or hydraulic presses somewhat similar to a letter-press, the two plates of which are hollow and can be steam-heated from an ordinary boiler. The lower plate is fixed in the screw-presses, but movable in those worked by hydraulic power. Objects made of mixed rubber are placed in moulds between the two plates of the press, which are strongly compressed and steam admitted to a pressure of 2½ to 4 atmospheres, corresponding to a temperature of 128 to 144° C. The length of time required varies according to the proportion of sulphur, the steam-pressure in the plates and the kind of mixture, but rarely exceeds two hours, and this is often reduced to one or even half-an-hour. In the case of vulcanising by S_2Cl_2, this is dissolved in carbon bisulphide and the objects are immersed in it in the cold. The next process to mastication is the incorporation of sulphur or the solid sulphides required for vulcanisation, and if necessary the various colouring and mineral or other ingredients employed for modifying the rubber according to the uses to which it is to be put. For the operation to be successful the mixing must be perfect, and the mass must form one homogeneous whole. The masticated and dried rubber is put through the mixer with 7 to 10 per cent. of sublimed sulphur, though the range is sometimes from 2½ to 25 per cent. In the latter case the excess can only be considered as an inert addition giving a fictitious weight to the manufactured article. 9 to 11 lb. of the rubber are passed repeatedly through the hot rolls, diminishing the space between them as the operation proceeds. As the sheet issues from the roll, it is dusted for the first time with sublimed sulphur and rolled upon itself, and again passed through the mixer. This is repeated until the requisite amount of sulphur, &c., has been added and thoroughly incorporated into a homogeneous mass. In this state, the mass which is still nothing but a simple mixture, is wrought in the ordinary way for its conversion into threads, sheets, tubes, shoes or any other object of definite shape. It is only now that vulcanisation is effected.

TREATMENT OF RAW RUBBER.

The rubber as imported into England in the various forms now to be seen in the Exhibition first undergoes a process of softening, washing and mastication to remove solid and other impurities. This is effected by immersing in hot water in wooden vats for 12 to 24 hours, and then by passing it in small quantities at a time through very powerful rollers revolving at different speeds, which tear and compress the rubber, while a stream of water from above washes away all the impurities in the form of wood, bark, stone, &c. The rollers are made of hardened cast iron and are usually grooved spirally or in the form of lozenges so as to facilitate the shredding and mastication. Their distance apart can be adjusted by tightening screws, and beneath them is a wrought-iron collecting tank covered by a perforated plate. The rubber after being passed through several times appears in the form of a long strip of lace-work similar to that so largely manufactured in the Malay States. This process requires much power—a machine capable of working 20 to 30 lb. of rubber at a time, requiring at least 15 to 20 H.P. actual. Rubbers vary as to the ease with which they can be washed, but Para is the best in this repect, as it contains fewest impurities. The rubber has now to be dried, which is effected by spreading on iron wires or in stoves capable of being heated to 50° or 60° C. 12°-140° Fahr.), care being taken to dry the greasy and pitchy rubbers at as low a temperature as possible. In many cases the sheets soften and fall to the ground in lumps, from which the moisture can only be evaporated with great difficulty.

The drying room should have a free circulation of air, and the darker it is maintained, the more valuable is the resultant dried rubber. The rubber is then stored until required for industrial purposes.

THE MASTICATION PROCESS.

The loss in weight in washing and drying of raw rubber is very variable, sometimes rising as high as 60 per cent in inferior kinds, while hard Para loses 10 to 16 per cent, and plantation Para only 1 to 4 per cent. When required for manufacture, the rubber has to undergo a further process of mastication or kneading by frequent passing between massive, hollow steam-heated rollers over 4 feet long and 19 inches in diameter. One roll is usually smooth, the other grooved, and they revolve at unequal speed, the latter twice as rapidly as the former. The distance apart is capable of regulation, and the rubber is forced through again and again until it becomes perfectly homogeneous in character. Great care is necessary in the process, which, if the rubber is not perfectly dry, takes from 40 to 50 minutes, according to the amount of moisture that has to be evaporated. In most factories, rubbers from different sources are masticated separately—some African varieties, which become tacky under the action of the hot rolls, taking a much longer time, and their sticky character necessitating the addition of a little talc (hydrous silicate of magnesia).

THE VULCANISER.

I would here like to briefly describe the form of vulcaniser. This is a small vertical boiler with a small copper cylinder into which the objects you wish to vulcanise would be placed. Water is placed in the cylinder and the whole apparatus is closed and heated until the steam pressure reaches 3 to 4 atmospheres. With a low proportion of sulphur in the rubber, vulcanisation can take place in about half-an-hour. With a high proportion you want 3 to 4 hours to vulcanise. The actual time required for vulcanisation is one of the most important points, and it is very easy to spoil a whole batch of goods by a half, or even a quarter of an hour's over-vulcanisation, so that when you have perhaps a ton or more of manufactured articles in these large cylinders being subjected to the vulcanisation process, it requires a large amount of experience to know exactly when the articles are likely to be over-vulcanised; otherwise a little over-heating might spoil them entirely. You have all seen in the Exhibition the various kinds of rubber which have to be vulcanised, including large blocks which have to be torn and macerated and mixed with sulphur or other powders until the mixture becomes perfectly homogenous—that is to say, that if you cut a section and put it under the microscope the whole section is perfectly uniform. From the description I have given, you can see an enormous amount of time and power is employed in this process.

TO SULPHURISE RUBBER IN CEYLON.

What we propose to do out here is to save that time and power by adding sulphur or sulphur compounds to the latex direct from the tree. I have here a sample of latex. I do not know the exact proportion of rubber in this latex, but it is very easy to ascertain the amount. You then would add a measured quantity of this sulphur solution, of which you know the exact proportion of sulphur, and you will see that it is capable of instantaneously mixing with the latex, so that a perfectly intimate mixture is obtainable. This would be done in huge vats, and it would mean that the latex from various estates could be amalgamated and a very uniform product obtained. By a slight stirring you get a perfect admixture. On the addition of the acid to this rubber—in the usual way you coagulate rubber in Ceylon—the sulphur would be thrown out of solution, but as the sulphur is in an extremely fine state of division, you will find no sedimentation and it is thrown out

through the whole mass of the latex. The acid while throwing out the sulphur, causes coagulation of the rubber particles throughout the mass with the result that the sulphur is thrown in contact with every molecule of rubber. You can tell the end of the reaction by the ordinary litmus test which will turn red on the slightest excess of acid. It is advisable not to add a great excess of acid either in the vulcanisation process or in the ordinary process, as there is no doubt an excess of acid has some effect on rendering the rubber more liable to become soft and tacky. I believe the original idea of coagulation with acetic acid was that the rubber particles rose to the surface and then set to a solid mass. That is not the case. Rubber sets throughout the whole body of the liquid, and being lighter that the water it contracts on itself and rises to form a layer on the surface.

COLOURING OF LATEX.

[The colouring of latex by organic dyes was then demonstrated, and Mr. Bamber went on to say this would be useful for the manufacture of children's toys as there will be no necessity for poisonous colours being put on the outside, as the colour will be mixed throughout the rubber.]

You will see that this process will mean an enormous saving of time and labour, and I think myself we will ultimately obtain stronger rubber, and instead of using 8 to 10 per cent of sulphur, we will only have to add one or 2 per cent. I have here some samples of rubber produced in this way, the strength of which compares very favourably with rubber as ordinarily produced. At the same time that I was making this sample, I made a biscuit from the same latex without any admixture of sulphur or any ingredient. This was dried and treated exactly in the same way as the other biscuit—under the same conditions and on the same bench—but within a week it ran into a soft tacky condition, whereas in none of the sulphured samples was the slightest tackiness shown. I think this antimony solution and the sulphur itself has a very strong antiseptic effect on the rubber. I should like, if possible later on, to show how vulcanisation actually takes place, as small articles can be done here. Unfortunately the vulcanising press I expected has not arrived, and will not be here for another fortnight. (Applause.)

DISCUSSION.

Mr. JAMES RYAN said he had to thank Mr. Bamber for much valuable information, but at the same time he noticed Mr. Bamber had used the Centigrade scale in making his calculations, and he would like to give the figures mentioned in Fahrenheit, as follows:—

112°	Fahr.	=	50	Centigrade.
140°	,,	=	60	,,
262°	,,	=	112	,,
291°	,,	=	144	,,

They would notice that the lower scale was below the boling point of water, and the higher scale was considerably above it.

Mr. BAMBER:—I am sorry I did not give the three figures. I had them here, but I did not think it was necessary. (Laughter.)

Dr. WILLIS remarked that the future would be in the possibility which Mr. Bamber had briefly indicated of the vulcanisation, colouring and otherwise treating of rubber in the state of latex instead of allowing it first of all to be coagulated in block or biscuit, whichever it might be, and then breaking it up and practically reconstructing it, as a great many did into sheet, containing sulphur and other compounds intimately intermixed with it. It appeared to him there must be a loss of strength in the rubber by that method of treating it,

and it seemed to him that they should first of all sulphurise the latex and then work it straight off into any manufactured form they desired. Whether thereby they would be able to count upon a considerable gain in strength, of course, was a matter for future determination. No one knew much about it at present, but the manufactured article did not appear to be equal in strength to the raw rubber as it came from the grower or collector in the jungle; but one had to remember that the manufactured article mainly consisted of adulteration if he might use the term. (Laughter.) He recently saw in the first page of a standard work on rubber manufacture Jean Jacques Rousseau's remark, that adulteration was used to such an extent as almost to lose all the properties of the raw rubber. It was by that process of adulteration that we were able to get rubber goods comparatively cheaply. One paid very little more for the manufactured rubber than for the raw product. It seemed to him that we should be able to make these additions out here instead of leaving it to the home manufacturers.

"FLYING AT THE THROATS OF THE MANUFACTURERS."

Mr. Smithett (London):—There is one thing, I think, that planters should consider in regard to this question of vulcanisation, and that is, that they are flying at the throats of the manufacturers. The rubber output from Ceylon and the Straits Settlements and the Malay States is a very small thing at present, and it will be some years, even taking Mr. Wright's figures yesterday, before it will be equal to, or at any rate, supplant the wild rubber. The wild rubber comes in the natural state to England and the manufacturers know how to deal with it, and there is nothing that the manufacturers object to so much as having the article partially prepared for them. We saw this, as the other judges and people present from London will bear me out, in the manufacturers' objection to crêpe; they are getting over that objection gradually now, but they objected to it because it was washed rubber. Anyhow for a good many years, it will be advisable, until Ceylon and the Malay Archipelago can control the rubber market, that they should send as pure an artiele as possible, and not to try, if I may say so, the experiments in sending the manufactured article or even partially manufactured article, which would simply annoy and worry the ordinary manufacturers. I think the lecture has been very interesting, and while I think Mr. Bamber has earned our best thanks for it, I should like to give this word of warning. (Hear, hear.)

Mr. Ryan:—As a wholesale producer I coincide with what Mr. Smithett has said. It never pays the wholesale man to go behind the retail trade. That is the one lesson which all Exhibitions have taught us; that is—give every man his little bit of jam. (Laughter.) If you try to take away the jam, you make him your enemy instead of your friend. Our business is growing rubber. At the same time there is no harm in our making experiments calculated to improve our manufacture. (Hear, hear.)

Mr. Bamber said he wished it to be clearly understood that he did not think planters would ever go in for this individually on their estates. What he did think might happen was that some manufacturers from England or America, or possibly Germany, might buy the latex up out here and make their sulphured rubber. He did not think it was a process for the planter but for the manufacturer, who if he saw a saving in labour, time or money would undobtedly take it up in the near future.

Mr. Zacharias said he was sure they were all very much indebted to Mr. Bamber for his illuminating lecture that day. He quite agreed with Mr. Smithett that until the supplies of rubber produced in Ceylon and Straits were very much larger than they were at present, the vulcanisation process

would hardly be advisable out there. But there was another point to which Mr. Bamber called their attention, and that was the question of tackiness. Tackiness, as they all knew, was their great enemy, and Mr. Bamber had told them that he had reason for believing that it was due to oxidising enzymes and bacteria or fungus of sorts. He did not know whether that had been found out before, or whether the honour rested with Mr. Bamber of having discovered it, but at any rate it would be one of the most important results that they would take away with them from that Exhibition. (Hear, hear.) If tackiness was due to fungus, he took it all rubber would be dealt with in some such way as in the Amazon, either by aseptics or antiseptics. Mr. Bamber had already told them that great cleanliness would prevent tackiness. Another point was the use of antiseptics, and he would like to know whether it is possible to prevent tackiness by adding some creosote. A few days ago he had a talk with Dr. Willis, and he was of opinion that it would be quite possible to use creosote. He (the speaker) would be very glad to hear whether it was possible to do that, and whether any experiment that had been made showed that rubber thus treated was inferior or superior to the ordinary article. At the same time they all knew that the rubber as got from Brazil was smoked, and the smoke contained creosote and acetic acid, and this would tend to show that drying rubber with a very fine solution of creosote would be the right thing. At the same time Mr. Bamber had told them that morning that acetic acid, if added in any surplus quantity, had just the opposite effect, and he was sure they would all be obliged if Mr. Bamber would further elucidate these few points.

FACTORY RUBBER.

Mr. Bamber said, as regards the question of bacteria and fungi in tacky rubber, he worked that out about a year ago. He sterilised some rubber and inoculated it under very careful conditions with slight traces of tacky rubber. He was by this means able to inoculate a piece of sterilised rubber and the tackiness spread rapidly through it. He also got Dr. Castellani to work with him, and he found certain bacteria, one or two varieties of fungus, growing on the new tacky rubber. He also found, as he had said before, there was an oxidising enzyme present in most cases where the tacky rubber was very bad. As regard the use of antiseptics he has always pointed out that, in his opinion, the rubber factory ought to be as perfectly clean and pure as the best dairy. In going through some of the estates one saw tins and buckets—at least he saw them some time ago, for he had not been recently—soiled, and with putrefying rubber from previous collections coagulated round the sides. He knew from his own experience that the sap in the latex encourages the growth of bacteria. With regard to the use of creosote he thought it would be quite possible, and he would be glad to try it by the addition of alcohol or an admixture with some oil which would not affect the rubber. He did not think it was necessry if there was was perfect cleanliness in the factory; but one had always to remember in tapping, when new trees were coming in day after day, that in the first tapping they cut through the sap vessels as well as the laticiferous tubes, and thereby got an admixture of sap in the latex with its sugar and other constituents prone to decomposition. He did not think it was absolutely essential to add any creosote or any other antiseptic, though it was not always possible to keep a factory as clean as one would wish. He had seen rubber treated with creosote, and there was no doubt that it was rather stronger, and it possibly had an effect of increasing the toughness. In any case he would be glad to make experiments in that direction.

TREATING LATEX WITH SULPHUR.

Mr. Herbert Wright:—There are one or two questions I should like to ask Mr. Bamber. With regard to the subject of treating the latex with sulphur compounds, I should like to ask one or two questions. I presume it is essential to

treat the latex while in a liquid condition with these compounds. Is it possible to carry on such work on an ordinary estate, or must the whole of that latex be sent down to some central factory in Colombo or Kandy, or wherever the most convenient centre may be? If it is necessary to send down the whole of the latex to a central factory, I am rather afraid there may be some difficulty in fixing its real value. From day to day on different trees, on different estates, and on different days, we know that the composition of latex varies considerably. It is not enough to say here are a few gallons of undiluted latex, because the samples even from different trees on different days may possess anything you like from 40 to 90 per cent. of water; so it seems rather difficult if you have a central factory to really arrive at a satisfactory arrangement; but if it could be carried out on the estates then I think the idea would be more congenial.

Mr. Bamber, replying to Mr. Wright, said it was quite possible to add solid sulphur compounds to the freshly coagulated rubber and mix it in the ordinary machines, but he did not think himself there would be any difficulty in ascertaining the correct amount of rubber in the latex. If the rubber was sent down in casks to a central factory, it would be well mixed before it reached the factory, and it would be easy to accurately ascertain the amount of actual rubber in it from a proportionate part. They could take out a sample, cure it in a few minutes compress it between drying sheets, and then weigh the rubber, and they could calculate how much there was in the total bulk of latex of actual rubber. It would be quite simple if they did not wish to wait until the rubber dried to make out a table with the corresponding weights of wet and dried rubber. As regards the specific gravity, the readings were far too uncertain to draw correct deductions from as to the amount of rubber in the latex, because it varied so much with the matter in solution either from the latex itself or sap.

Mr. Wright:—Then I take it that the planter would not really know the value of the latex he sent until it had been determined at the factory. He could, of course, take counter readings.

Mr. Bamber:—It would be possible for the planter to do it himself before sending it away.

Mr. Wright:—In association with that it might be possible to accumulate latex in large quantities and keep it in a liquid condition by the addition of ammonia. We have been making experiments here with the different latices, and our idea has been to find out how long the latex can be kept in a liquid condition by the addition of formalin or ammonia, and I should rather like to ask Mr. Bamber whether, in the event of its being necessary to keep latex in a liquid condition for several weeks, it is likely certain chemical changes might not take place. I have samples of rubber prepared from latex kept for six weeks, and I am sorry to say they are inferior; while one might have expected them to be perfect. I am speaking with reference to Para rubber, and Mr. Bamber will perhaps tell us whether any chemical change does take place.

Mr. Bamber said that he did not think when formalin is used there was much chemical change, but in the case of ammonia he thought it was quite possible, there would be some change. He had kept latex in his laboratory for two or three weeks without any deterioration whatever.

Mr. Wright:—Two or three weeks!

Mr. Bamber:—I think I could have kept it six or ten weeks. The only thing he saw was that when he worked it into biscuits it coagulated a little more rapidly than when it was fresh. The moment the acetic acid was added, the whole at once set into a solid mass which was in a way rather a nuisance as they did not want it to set too quickly. He did not think there was any fear so long as there was no excess of formalin—more than sufficient to prevent bacteria forming.

Mr. Carruthers said he should like to be allowed to say that among the interesting lectures and conferences there, that lecture was one of if not the most interesting, and he thought there was no doubt they could say, almost without exaggeration, that that might be an epoch-making paper read to them by Mr. Bamber, and it was possible in the future it might cause great changes in the rubber-producing industry. At the same time he was very glad Mr. Smithett told them quite plainly the position of the men at home, and it was well the matter should be looked at from a practical point of view. The subject might have come better if it had been brought before them by a home manufacturer and not by their friend, Mr. Bamber; but at the same time he was rather glad that Mr. Bamber should have been the man who should have discovered and originated this possibly entirely revolutionary notion with regard to rubber. (Applause). When the producer in the Federated Malay States began to manufacture crêpe, as Mr. Smithett had told them, and after visiting the manufacturers at home, he had come to the conclusion that they were fighting shy of crêpe simply because they were treading on their corns and trespassing on their grounds in regard to the manufacture—he had no doubt directly they began to suspect any rivalry they would have difficulty with them. He thought that with due caution they should keep that matter in the back of their heads at present. That process of Mr. Bamber's would help them in the future, but he thought they ought to "ca, cany" at present. There could be no doubt, as Mr. Bamber's arguments showed, that the proper time to mix any substances with their rubber was when it was in the form of latex. He thought it was an important original idea. They were there hearing a most interesting paper, and he was not sure but that it would be better to treat it at this stage as an interesting paper and not one that planters can actually accomplish. (Applause.)

Dr. Cuthbert Christy said he could not talk of the vulcanisation of rubber as he knew nothing about it, but there was one point with regard to the keeping of latex to which he would like to refer. There was little doubt but that could be kept for a long time. He had had experience in London with samples that were over two months old with the addition of a little formalin. They were perfectly good and formed excellent biscuits. The only chemical action that had gone on was the formation of sulphuretted hydrogen. The latex was perfectly good and produced perfectly good rubber although one or two months old.

Mr. Ryan said in corroboration of what had been said by Dr. Christy and Mr. Bamber, he might mention that for many years from Nigeria and the French Congo they had been in the habit of exporting latex in casks which apparently reached the market, and presumably, as it was still going on, they found it paid to do so. They had river transport. Some four or five months ago he had exported two hogsheads of latex to London, and the commercial report on the resultant rubber was favourable. It arrived in perfect condition. The time in transit was 28 days. There was a delay of seven days in the London docks, and before it was actually treated it was about six weeks' time from the date it was despatched from Colombo. The remarks made by the manufacturers were to the effect there was a slight generation of sulphuretted hydrogen. That was the only change made in the rubber. (Hear, hear.)

Mr. Bamber said there was one other point which he wished to mention. Not very long ago, he saw a notice in the papers that they were exporting latex from Brazil to France with the view of making the rubber there, and he could not see himself why they should not be first in the field in that sort of work, though he quite realised it was premature at present. There was not a sufficient supply of rubber to make it worth the while of manufacturers coming out here to buy

latex, but he thought in the future they would come to this. It seemed to him rather absurd to make your rubber and then unnerve it again by various processes which he had described, mix it with sulphur, which was as they might imagine, one of the most difficult processes out, and re-form it in sheet. If they could make it on the spot—not themselves, but the manufacturers who could come out and make it—it would be a very decided step in advance and possibly make the demand for rubber greater.

Mr. Brett (London).—I am quite sure Mr. Bamber's description of vulcanisation must have been extremely interesting to all who have been present, and valuable in that way; but I think the difference between the part of the lecture which is merely informing, and that part which is to be applied in Ceylon ought to be emphasised. I understand that Mr. Bamber does not suggest that the actual vulcanisation should take place in Ceylon, but merely the process of combining the latex with sulphur. I mention this because it struck me that otherwise much opposition might be brought forward which might be avoided if this were clearly understood. There is one other point I should like to mention. Your Eastern rubber is being very largely used for experimental purposes at present, and every day the methods of preparation are being perfected. I have often heard it said that your rubber has a high standard of purity, and possibly in the future it will be possible to use it straightaway in the factories for solution purposes and so on, without any mastication or washing. (Applause.)

Mr. Bamber:—I quite agree with Mr. Brett. There is no intention to vulcanise, but the idea is merely to mix sulphur and various compounds out here with the latex and send it home to the manufacturers as sheet; but that would be done not by the planters, but by the firms of manufacturers coming out and doing it themselves.

Mr. Devitt (London):—I should like to ask, if the market is bad and a planter has two or three thousand gallons of latex on his hands, how is he to store it? He might have to hold it two or three months. Each planter would have to have a place to store it in; if not, he might have to sacrifice it at whatever price he could get.

Mr. Wright:—You would still have scrap rubber to deal with.

Mr. Ryan:– We could manufacture in the ordinary method. In that form rubber does not deteriorate quickly.

ACTION OF AMMONIA AND FORMALIN ON LATEX.

Mr. Wright said in regard to the maintaining of latex in the liquid condition for a long period, there were persons who were afraid to add any chemical agent whatever to the latex, and he wished Mr. Bamber would definitely explain the action of ammonia and formalin. He estimated, though he might be quite wrong, that the addition of ammonia did not prevent decomposition, but it simply neutralised the acids formed in decomposition. On the other hand he took it that formalin acted in a quite different manner and prevented the original decomposition, so that formalin would have preference over ammonia, while it could be driven off easily by the application of heat.

Mr. Bamber said the action of ammonia and formalin was exactly as described by Mr. Wright. The ammonia combined with the acid produced by decomposition by the action of bacteria, whereas formalin prevented the development of bacteria at all; and, therefore, there was no chemical change except possibly the production of sulphuretted hydrogen, which he had not heard of before it was mentioned that day. He did not say that no chemical change at all would take place. Changes might take place owing to variations of climate and temperature, but they would not be due to formalin.

Mr. Ryan :—To put it briefly, ammonia is anti-acid and formalin is antiseptic.

This concluded the discussion ; and a vote of thanks having been passed to Mr. Bamber for his lecture, those present separated.

REPORT UPON A VISIT TO GREAT BRITAIN TO INVESTIGATE THE INDIA RUBBER INDUSTRY IN ITS RELATION TO THE GROWTH AND PREPARATION OF RAW INDIA-RUBBER IN THE MALAY PENINSULA. III.

By P. J. Burgess.

IN THE HEAT CURE.

23. The raw rubber and finely-powdered sulphur are mixed together intimately on a mixing or a masticating machine. If other ingredients are to be added to the rubber, it is done at the same time that the sulphur is incorporated. Chemical union between the sulphur and the rubber takes place neither during this mixing nor afterwards, as long as the mixture is kept cold. If, however, it be heated to about 300° F. chemical union takes place slowly, and the new product, vulcanised rubber, is formed. By far the greater bulk of rubber is vulcanised in this way. The hot chambers in which the actual heating and vulcanisation are carried out are of several types, and differ in the way in which the heat is applied. Where pressure has to be exerted on the rubber during vulcanisation the goods are vulcanised in moulds, between large plates of iron, which are hollow and heated by steam. In other cases, large chambers heated by steam are used, and into these the rubber goods, placed on trays and smothered in French chalk, are taken. Fabrics coated with rubber –such as sheeting and mackintosh cloth—are wound round a large iron drum and immersed in water, which under pressure is heated to the required temperature. Long tunnels, 50 or 60 feet long, dry heated by steam, are used for vulcanising hose pipe and lengths of tubing which cannot be coiled. The temperature is regulated so as to slowly rise to about 300° F., and after maintenance at that point for a period varying from half to three hours, it is slowly allowed to drop again. During vulcanisation a portion of the sulphur combines with the rubber and forms the new addition compound, which is quite distinct from raw India-rubber, and from which the sulphur cannot be removed by any known process. Although the whole of the rubber is acted upon by the sulphur to a greater or lesser degree, the action is slow and the whole of the sulphur present is not used up during the short period that the vulcanisation lasts, and free uncombined sulphur remains disseminated throughout the vulcanised product. A prolonged period of heating during vulcanisation diminishes the excess of sulphur, and leads to the production of more highly vulcanised rubber. The more sulphur which vulcanised rubber has used and actually combined with, the darker and harder the product until the extremes of vulcanite and ebonite are reached. From partially vulcanised goods the excess of free sulphur can be chemically extracted, and this is one of the operations in "recovered" vulcanised rubber; the combined sulphur, however, remains always in the recovered rubber. The recovery of rubber, therefore, is an operation by which the mechanically mixed substances, such as the excess of sulphur and the fillings with which the rubber was mixed in manufacture, are wholly or partially removed, and the residue resulting is worked up into a form in which it can be blended with new rubber, and act as a substitute for a portion.

COLD CURE.

24. Although pure sulphur does not combine with india-rubber at a temperature below 270° F., yet a compound of sulphur with chlorine—namely, monochloride of sulphur—does react on rubber, and the sulphur is transferred from the

chloride of sulphur to the rubber, and vulcanisation takes place rapidly and completely at ordinary temperatures. This action with pure chloride of sulphur is too violent; this agent is therefore diluted and a solution of 2—3% of chloride of sulphur in carbon bisulphide is used. The article to be vulcanised is immersed in this solution, and left for a few minutes, the time varying with the thickness of the rubber; it is removed, drained, and finally washed with water. The chamber in which this dipping takes place must be specially arranged to prevent the fumes of the solution, which are poisonous and corrosive, coming into contact with the workmen. This cold cure is used for goods which from their nature would be damaged by exposure to the temperature required for heat vulcanisation, and also for goods in which the presence of uncombined or free sulphur is objectionable, or which have been made by accumulation of rubber by dipping in rubber solution, as is the case with teats for infants' bottles, and in some surgical goods.

SOLUTION MAKING.

25. In dissolving rubber for making solution or pastes for spreading on fabrics, benzole is the solvent generally used. The process is simple, the washed dry rubber is soaked in the solvent and then ground up with the solvent in enclosed boxes, in which are several pairs of small rollers which thoroughly mix the rubber and solvent, and according to the relative amounts of rubber and solvent produce a solution free from lumps. If a solution of plantation rubber be made by shaking rubber and benzole in a glass bottle, a turbid instead of a transparent solution results. This is due to a small quantity of a resinous body which is always normally present in all Para Rubber, and which is not soluble in benzole. The effect of the mechanical rolling in solution making in the factory, is to largely break up and incorporate the flakes of this resin and render the whole homogenous and transparent. Thorough mastication of the rubber also tends to produce this same result, and rubber after complete mastication is far more inclined to dissolve to a clear solution in rubber solvents than simple sheet, biscuit, or crêpe rubber. This point I mention because the solution of samples of rubber in solvents is one test of the purity of rubber, and the presence of this insoluble resin, which appears large in bulk, but which is in reality only a small fraction of a per cent., is apt to prove disconcerting to the person making the test.

FINAL MECHANICAL PROCESSES.

26. The detailed mechanical manufacture of the actual rubber goods of commerce can only have an indirect interest to the rubber grower; but though indirect, it is, I consider, sufficiently great to justify the inclusion of an account of some of these processes in this report. Much of my time was spent in acquiring knowledge of these details in the various factories I visited. These facts must be remembered in order to properly understand the final manufacture of rubber goods. The dough of masticated rubber, mixed with sulphur and other ingredients, is plastic and has lost the original elasticity of rubber. It can be cut and moulded, stamped into shapes, bent and twisted, just as putty, clay, or a dough of flour and water may. Rubber dough and masticated rubber are self-adhesive, and cut surfaces can be joined firmly together by simple pressure, and if the surfaces be brushed over with benzole the pressure required to form a very fine junction is of the slightest. On heating the dough and masticated rubber which contains sulphur, a chemical change takes place and a chemical compound of rubber and sulphur is formed which possesses the original elasticity and toughness of the raw rubber, but in a great and more perfect degree. This chemical change is called vulcanisation of the rubber, and it is the final process to which practically all manufactured rubber goods are put. It must never be forgotten that raw rubber and vulcanised rubber are quite different and distinct substances, their chemical compositions are

different, their properties both physical and chemical are quite distinct, and moreover though the change from raw rubber to the sulphur compound of rubber—that is, vulcanised rubber—can be easily effected by simple mixing and heating to 300° F., the reverse process of removing the sulphur and reforming raw rubber has never yet been done.

27. The vulcanised rubber goods which the manufacturer turns out may be divided into three main classes—I, stamped and moulded goods; II, goods built up of rubber dough and other material; and III, sheeted and spread rubber goods.

STAMPED GOODS.

28. All solid rubber articles—such as heel pads, soles for shoes, vulcanite stoppers, rubber rings, washers, mats. buffer and rubber pads, billiard cushions rubber tube, etc.,—are prepared direct from the dough by stamping them out by hand or by machines, coating them with French chalk to prevent adhesion, and then vulcanising simply by heating on trays or in iron moulds. The variety of goods of this kind is enormous and without limit, and doughs of most diverse composition from pure rubber and sulphur to mixtures where rubber is present in very small proportion, are used for this kind of work. This branch of the manufacture of rubber goods is as simple to understand as the art of the pastry cook, who stamps out fancifully shaped little cakes, or twists up curly bread, dredges with flour and bakes in an oven. The secrets are in the recipés for the dough, and the art in the manner of making the shapes and regulating the baking. There are many ingenious and complicated machines used to save labour, but some of the simplest articles no machine can yet produce, and hand labour has to be employed. Rubber rings of circular cross section, commonly called "umbrella rings," have all to be made up by hand. If stamped or moulded the strength is not to be relied upon. The mode of making is ingenious. A long strip is cut from a thin sheet of dough, and this is cut into lengths of a few inches, not by simple cross diversions but by oblique cuts. These lozenge-shaped strips are then wrapped round a smooth circular rod and the sloping ends pressed together. A band is thus formed round the rod and the line of junction of the two original ends of the strip passes obliquely across the band. The workman, or rather workwoman, then rolls up into a ring with her fingers this flat band, still upon the rod, and by rolling it backwards and forwards upon the rod makes a smooth ring of it. The object of cutting the strip with oblique ends—or "on the cross"—is now evident, because the line of original junction which naturally would be the weakest place in the ring, is spread out over a considerable length of the ring, and it is everywhere wrapped round and supported by whole and unjointed layers of rubber, becoming thus nowhere more than a small portion of any part of the cross section of the ring. Screw stoppers for bottles are mechanically stamped out of a dough which contains a high proportion of sulphur, and which gives a hard product on vulcanisation, the dough is stamped in two stages, first a simple cylindrical rod is made and cut lengths of this are then fed into a powerful press which produces the final shape. For large and awkwardly shaped goods, such as the outer covers for pneumatic tyres, specially devised iron moulds to completely encase the tyre and exert pressure upon it during vulcanisation are prepared. These moulds are in several portions and have to be fitted round each tyre separately and the portions keyed into contact. Flexible rubber tubing where the rubber is solid and not, as in piping associated with canvas, is squirted out of a machine provided with compound nozzles, the apertures in which are ring-shaped. The rubber dough is ejected through this annular orifice as a hollow tube which only requires heat vulcanisation for completion.

A detailed account of the mechanical difficulties encountered in this part of the work, and the way they are surmounted, would be of little use and certainly

tedious; the principal underlying all processes is the same—namely, moulding plastic dough and then reproducing the elasticity and tenacity of the rubber goods by heat and vulcanisation.

29. Rubber goods that are "built up" fall naturally into two classes, according to their being pure dough or compounded with other materials, as in the case of outer covers for tyres, hose piping, rubber belting, etc. The general mode of treatment is the same in all cases, and it is a mixture of joinery and tailoring. The dough is soft and plastic and so can be rolled to any thickness, cut to any shape, and applied to the goods in any manner. The dough contains raw rubber and therefore is adhesive; cut edges of it can be pressed into contact, and that with the greatest ease, if the edges or surfaces are previously moistened with any rubber solvent. The tools necessary for use in this work are consequently of the simplest—a keen knife or stamps for cutting shapes, a squeejee for pressing surfaces into contact, and a pot of benzine with a piece of cloth as a sponge for moistening, with this solvent, edges to be stuck together. The goods built up in this way are, as would be expected, of extremely diverse character, and in some instances most ingenious methods to overcome special difficulties are practised. The process of making Indiarubber balls is a case in point. Rubber dough in the form of sheets is cut into oval pieces of precise size with a knife and a metal shape, the edges being cut bevelled. Three of these ova pieces are applied together by their edges which are firmly cemented with the assistance of a little benzole, forming very roughly a hollow ball. An aperture of about an inch in length is left between the edges of two of the pieces, a small lump of pure masticated rubber is stuck to the inside of one of the pieces, and the position of this indicated on the outside with a spot of paint. A pinch of ammonium carbonate is then put inside the ball, and after examining the joints inside the ball with the aid of a little electric glow lamp the aperture is sealed up. The balls are then put into moulds and vulcanised by heat. The object of the ammonium carbonate is here seen. This substance on heating to the temperature used in vulcanisation is completely vapourised, and this vapour exerts some pressure inside the balls, blowing them out tightly against the spherical moulds in which they are being heated, rendering the shape exact to the mould and assisting in ensuring perfection of the joints; on cooling the solid ammonium carbonate is again reformed and the balls are limp and under no pressure when removed from the moulds. A hypodermic needle connected with air under pressure is then thrust into the ball at the point where the lump of raw rubber was stuck inside. The compressed air is turned on and the ball inflated to its proper size, as shown by a gauge. On withdrawing the needle the aperture left in the lump of rubber inside, which contained no sulphur and which is therefore unvulcanised and sticky, at once closes and seals up the hole, a dab of solution is pricked into the hole in the outer cover to close this up also, and the ball is ready for use, ready to be painted and enamelled in gaudy colours and sold as a toy, or to be covered with cloth and become a tennis ball for men. Most hollow air-tight rubber goods in one piece are prepared in this way, the presence of a lump inside may be taken as a certain indication of it. Hose pipes are constructed by being built up round iron tubes, 60-100 feet in length. Strips of canvas, coated with a film of rubber, layers of dough on canvas, and again canvas coated with a film of rubber are wrapped simply, without any spiral twisting, in layers over the inner core: the layers are all stuck together and squeejeed into a firm union, and then vulcanised. To extract the inner iron tube from the vulcanised pipe air is forced in between this tube and the outer hose pipe, which can then be easily slipped off the iron tube,

SPREAD AND SHEETED GOODS.

30. This class includes all the waterproof fabrics from the coarse and heavy waterproof sheet of which the basis is a canvas, to the lightest and thinnest cloth

for wearing apparel. This is one of the very important uses of rubber and is responsible for the consumption of a great part of the fine Para imported. Here probably plantation rubber would be of great use, being pale in colour, clean and free from offensive odour, provided that the lasting properties of the rubber are not injured in the preparation.

Fabrics are coated with rubber in two ways. The rubber may be made into dough by masticating and mixing with sulphur and other ingredients and spread in this condition on the fabric by means of heated rollers; or the rubber, sulphur and mixings are made into a paste with a rubber solvent, and this paste is spread on the fabric by the aid of rollers, and the solvent dried off by passing the fabric over plates heated by steam.

For vulcanisation, the heat cure, using steam or water, is usually adopted. The machinery necessary for spreading rubber is heavy and costly, the rolls are of polished steel about 2 feet in diameter, and each machine has at least three, and may have four, rollers arranged vertically above each other on horizontal axes. The fabric is rolled over the top roller, round between this and the second, an even tension being thus given to the cloth, and finally it emerges between the second and third. The rubber as dough or paste is spread on to the fabric from the face of the third roller, as the cloth passes between it and the second. There are machines for spreading simultaneously on both surfaces of the cloth, and many different details in the actual mechanism of the spreading. The rolls are called calanders, and the machines are very similar to the calandering machines used in paper manufacture.

31. There are many forms of India-rubber goods which cannot justly be placed under any of the three previous clauses, but which deserve some mention here, especially as they are made for the great part from rubber of the finest quality, and for which plantation-grown rubber is at present never used.

CUT-THREAD AND SHEET.

32. Cut-thread is the name given to rubber in the form of thread, or strands of square cross section cut from solid sheets of rubber already vulcanised. This rubber thread which when fine is woven into elastic webbing, is all of the best possible quality, and special nerve, elastic and keeping properties are demanded. The amount of labour which is actually spent on the rubber would make it a false economy to use untried cheap rubber, and makers of cut-thread will not use at present plantation rubber for this process. Each manufactory has its own special methods for actually cutting the thread, and details of the machines are jealously guarded as secrets. I was, however, admitted in several instances and saw rubber being actually cut into threads by multiple scissors and knives, the thread afterwards being powdered and spooled and wound into hanks. The details of the cutting I shall not attempt to describe.

Cut-sheet is made from large blocks or cylinders weighing about half a ton, the cutting being done by a blade four to six feet long, which is rapidly oscillating with a saw-like movement, and which is well lubricated with water or soap and water. Sheets cut in this way show a fine striation due to the little ridges which mark the progress of the knife at each stroke along the block or cylinder. A good tobacco pouch is usually made from this cut-sheet and shows the appearance described. The most interesting feature in making cut-thread or sheet to the man interested in rubber is the process of preparation of the rubber into blocks ready for the knife. The utmost care must be taken in the preliminary washing, and if any grit be in the raw rubber the washed sheet is subjected to a final cleaning between smooth and hardened steel rollers which crush the grains of sand which are then washed out. The rubber is then well masticated and mixed with sulphur

and whatever other ingredients may be required. The rubber is then forced by hydraulic pressure into huge iron moulds which will contain sometimes as much as a ton of rubber, and which are rectangular or cylindrical according to the type of machine which is to cut sheet from them. Special care has to be taken to prevent the inclusion of air bubbles in this block of prepared rubber. When rubber is compressed in this way into cylindrical moulds for manufacture of cut sheet an axle of steel is forced through the centre of the mass while still in the iron mould. The moulded mass has then to be annealed by gentle heating and maintaining it at a moderate temperature for some little while. The next process is to harden the block by freezing for a week in a refrigerating room, where it remains after removal of the mould until wanted for use. The cutting edge of the knife, and the surface of the rubber, are plentifully lubricated with water during cutting, this also fulfils the further purpose of thawing the immediate surface of the rubber and bringing the rubber to a suitable condition of hardness for the operation. The sheets when cut must be carefully handled, being still soft and self-adherent, unvulcanised, though perhaps containing mixed sulphur.

DIPPED GOODS.

33. There is still another mode of manufacture of hollow rubber goods which may be called the dipping process; it is simple in principle and very similar to the way in which the old-fashioned tallow dip candles were made. A thick rubber solution is prepared, usually of pure rubber and solvent, though pigments may be mixed with it. A mould representing the internal shape of the required article is dipped into this liquid and withdrawn. The solvent evaporates leaving a film of rubber on the moulds, the operation is repeated until the required thickness of rubber is accumulated. Any manipulation or cleaning of the edges is now carried out and the rubber still on the mould is vulcanised. Here the "cold cure" has to be adopted, since the rubber contains no sulphur already mixed, and the customary solution of 3 per cent. of sulphur chloride in carbon bisulphide is employed, as previously described under the head of vulcanisation. Certain classes of surgical rubber goods are made in this fashion, and india-rubber teats for feeding bottles are turned out by the thousand. A final dressing of rubber enamel is often given to goods prepared in other ways, such as enemas and india-rubber balls, by painting with or dipping in a rubber solution heavily loaded with pigments.

ELECTRICAL USE.

34. Rubber as an insulator of wires for cable use is being rapidly discontinued, owing primarily to the high price of raw rubber. For sea cables rubber has never been much used, gutta percha of course being superior, but land cable carrying telephone wires, and which at one time were insulated with rubber are now being largely insulated with dry paper. Heavy cables for electric light supply are demanding for use in their manufacture less and less rubber every year, its place being taken by papier-mâche and cellulose pulp. For the flexible wiring containing a single or a few strands of wire, such as are used in houses for electric bells, lights and telephone communication, rubber is still employed, paper here is inadmissable because it is less flexible, and also when exposed to the air becomes damp and an inefficient insulator. The wire is coated with raw unvulcanised rubber by wrapping a narrow strip, cut from thin sheet round the wire and pressing the adhesive edges together. This is done by a machine which feeds the rubber slip from a spool on to a travelling wire, the pressing together of the edge is done by running the wire coated with the strip through guides and between wheels. Paper when used as an insulator is wound round the wire spirally. The use of rubber for electrical purposes in the form of ebonite fittings is considerable, but a great extension of the electrical application of rubber consequent on any reduction in the price of the raw material must not be expected.

THE INDIA-RUBBER MANUFACTURERS' ASSOCIATION.

35. This Association, which was formed seven years ago to promote the interest of the rubber trade, and "especially with reference to legislation and to difficulties in the general conduct of the business," is one exclusively of firms possessing india-rubber works, and includes twenty-five of the india-rubber manufacturing firms of Great Britain. General meetings take place once a month in Manchester, and on June 21st and again on July 20th I attended the meetings and gave addresses on Plantation Rubber and the Progress of Rubber Planting in the East. Samples of washed plantation rubber and of rubber latex, both from *Hevea brasiliensis* and from *Ficus elastica* were shown, and the photographs to illustrate modes of tapping and the growth of the trees were exhibited and described. This opportunity of meeting the heads and representatives of large manufacturing interests, and of putting the problems of rubber cultivation and preparation before them from the planters' point of view, was of the greatest value, and the views which I had been gradually ascertaining were perfectly confirmed. At the same time, the interest taken in England in rubber growing was stimulated by having the conditions under which that work is done expounded. I should recommend that communication be established between the United Planters' Association and the Association of India-Rubber Manufacturers, and that questions which may arise from time to time be freely discussed between the two Associations, and I am confident that any help which the India-Rubber Manufacturers' Association could give, in this way, to rubber planting would be freely at the disposal of the United Planters' Association. The following is the name and address of the Secretary of the Association.

F. B. KNOTT, Esq., A.S.A.A.,

2, Cooper Street, Manchester.

INFORMATION ABOUT THE MALAY PENINSULA IN LONDON.

36. At present there is considerable activity shown in London amongst controllers of capital in rubber planting in Ceylon and the Malay Peninsula, and every sign of still further advance in this direction. From the point of view of the future interests of the industry and the permanent welfare of this country, the greatest encouragement should be shown to capitalists who intend to actually open up country and plant, rather than make profit by company promotion. In this connection there is an unexpected difficulty in obtaining information in London about the Malay States, and the conditions under which land can be acquired, held, and utilised, for planting. This acts as a distinct check to that class of investor which is most to be encouraged. Cases of this came under my personal notice; copies of the Land Acts and Ordinances of the Malay States and of the rules under these Acts could only be obtained as a favour from the Colonial Office; conditions of labour supply and all details connected with the manner and cost of opening and development of an estate at the present date, are difficult to obtain by the investing public, and steps might with advantage to this country be taken towards supplying the want, by the establishment of an office in London supplied with quite recent and reliable information on all matters relating to planting and agriculture in the Malay Peninsula.

P. J. BURGESS, M.A., F.C.S.,

Government Analyst,

SINGAPORE.

Rubber and Cotton in Ceylon.

By J. C. Willis.

A Lecture delivered at the Ceylon Rubber Exhibition Royal Botanic Gardens, Peradeniya, on September 14th.

Discussion on the Prevalence of Malaria in Labour Forces.

This lecture inaugurated the series of daily lectures which were given during the Exhibition. H. E. the Governor took the chair. The lecture was held in the Governor's Pavilion, and there was a large attendance, amongst whom weie the following:—Mr. J. R. Martin, Hon. Mr. E. Rosling, Mr. W. D. Gibbon, Mr. and Mrs. H. Glynn Eccles, Mrs. Willis, Mr. and Mrs. F. C. Roles, Dr. Cuthbert Christy, Mr. J. B. Carruthers, Messrs. T. J. Campbell, G. O. Trevaldwyn, M. Bremer, C. M. B. Wilkins, C. M. Buckworth, S. K. Dickon, R. Huyshe Eliot, J. B. Coles, M. Kelway Bamber, J. S. Patterson, H. de Saram, James Fernando, E. Wilson Dias, F. W. de Hoedt, W. P. H. Dias, R. D. Tipping, J. M. Urquhart, G. N. Thompson, A. H. Cameron, J. K. Nock, Dr. A. J. Cuntze, Messrs. J. B. Tennant, M. H. Lushington, W. Lyall, Mr. and Mrs. M. L. Wilkins, Mr. and Mrs. C. Northway, Messrs. G. A. Krumbiegle, W. A. Tytler, H. M. Alwis, E. D. Bowman, E. G. Windle, Dadabhoy Nusserwanjie, H. A. Webb, Dr. A. Lehmann, J. Cameron, R. L. Proudlock, C. Symons, L. Piachaud, A. N. Galbraith, H. M. Smith, Thos. Gidden, James Ryan, A. L. French, W. S. T. Saunders, R. Anderson and F. Hadden.

THE LECTURE.

Dr. Willis—who was cordially received—said that the title of his lecture showed that he was going to deal with the North country as suitable for rubber and cotton; and he would just like at the outset to make one explanation. Some people were under the impression that they could grow cotton successfully in "wet Ceylon," if he might use that phrase; but though in exceptional years it might be possible, as a rule it was not possible—and he was entirely against recommending anyone to try to grow cotton in wet Ceylon. [This he demonstrated by making a rough sketch of Ceylon on the blackboard. The mountains of Ceylon lay in a block. He drew a square by lines from the coast inland, one running from Negombo in the direction of Trincomalee and the other a little East of Matara, which, if continued, would come out about Batticaloa.] This was the wet region which got the rain of both the South-West and North-East monsoons. The remaining part had only rainfall in the last three months of the year, and for the rest of the year was comparatively dry.

They sowed cotton in September or October, and the first crop came in March, and if they got rain from March to the end of June their cotton crop would be more or less a failure. If it rained when the cotton was in the boll, that is when the pods fluff out, the cotton all crumpled up and no amount of drying would make it really good. They might dry it and get for it 2*d.* or 3*d.* less than they would otherwise, but by no amount of drying could they get a really first-class result. They now came to the subject of his lecture

RUBBER AND COTTON.

When the Northern country was opened by the extension of the railway, the question immediately arose as to whether some product suitable to the country could not be introduced, and naturally the first thing to be thought of was cotton. Government agreed to open an Experiment Station at Maha-iluppalama, 12 miles from Talawa station, and on the road which in the future would be the main road through the North-Central Province. The object of that experiment was to try cotton, and as soon as they got the cotton into shape they also tried rubber—that

being a fairly promising industry for the North country. For the first 9 to 12 months they had nothing there but cotton. They had enough difficulty with that. It was an extremely difficult country in which to get labour, and the coolies took life very easily and did not over-exert themselves ; and demanded 50 cents a day for doing it. It took a great deal of time and trouble and expense before they got things square and the cotton in. They got the land fairly clear, and rubber put out in October, 1904, and at intervals up till April, 1905. That was only about 16 months ago, and the trees were now from 8 to 15 ft. high—varying in height according to the time they were put in. The girth was anything from 3 to 6 inches, and the trees were growing very satisfactorily. Mr. Mee, who was in charge of the station, had had experience of rubber in Kalutara, and he thought that on the whole the trees were growing better than they did at Kalutara. Of course, they had not reached the tapping stage ; and until they had reached that stage, he would not like to make any definite statement that rubber would succeed. But if it succeeded, as it promised to do, it would open up a large area for cultivation when the lands in the South and South-East had been taken up. They had there a very good soil. A false impression had been publicly created about the soil in the North. It came out a great deal during the opening of the Northern railway, and it was described as a desert and nothing but gravel and sand. That was by no means the case ; and if anyone cared to go down to the station, they would see soil which could not be seen anywhere whatsoever in South Ceylon. Anyone who had visited the Experiment Station at Peradeniya knew they had very good soil there ; but the soil at Maha-iluppalama beat the Experiment Station there hollow and was really very good indeed. Of course, going down the North country people went by the North Road, and travelled along the highest ridge of the lowcountry, but if they came into the valleys there they would find a deep alluvial soil which ran 10 to 15 feet deep in the centre of the valley and tapered off to from 1½ feet to 5 feet deep on the sides. The depth of soil in the centre was at least 17 feet; they had dug that depth and still there was no stone to be seen, It was a perfectly soft blackish soil like an English garden soil, and its quality was extremely good. It was on the whole better than any soil they could see in the Central, South-East, or Uva Province, except some very fine soil on the eastern side of the range near Lunugala.

To return to the cotton crop, they sowed it in September and October according to the rains, and the first crop came in March. They must have fine weather from the beginning of February. The flowers came out in February: the first crop was in March, and the second six weeks later, and the third crop, which was a small one and hardly worth waiting for, came about the end of June.

They had had considerable difficulty with labour which cost them a good deal more trouble than it need have done. Of course they were pioneers, and he thought any one following after them would be able to bring coolies on advances and do it much cheaper. Since the railway had been opened, they had reduced their rates from 50 cents a day to 41·25 cents, a drop of 8 or 9 cents, and they seemed inclined to do a little more work than formerly. He would not trouble them with returns, but for their Sea Island crop, which was got off a field of 20 acres, they got R87 an acre ; and the return from the Egyptian crop, of which they had 30 acres at the end of 1904 and the beginning of 1905, was R71·25 an acre. The Sea Island cotton is, of course, the best grown in the world. It owed its quality entirely to selection of the seed, and if this were not very carefully selected the quality dropped immediately. Their seed was taken from a West Indian crop that sold for 1s. 2d., and they sold their crop for a shilling. Their seed had not been selected. The only people who could have selected it were the West Indian Agricultural Department; and they had their work cut out for them in selecting seed for themselves. They

were getting in the West Indies 1s. and 1s. 1d., but he saw in the last sale list that one or two got 1s. 8d. The price had steadily gone up by careful selection of seed. Their seed was not selected, and the price dropped from 1s. 2d. to 1s. in one crop.

Now, to take cotton and rubber together. He thought that in the North country there was quite a prospect, as far as they could tell at present, of a profitable industry in a species of cotton as a catch crop between rubber. They could not grow it in every district as a catch crop; but in the North country where it was dry it was quite feasible. [He drew a sketch on the blackboard illustrating how rubber and cotton should be planted together.] They planted the rubber 20 feet apart with irrigation channels running down midway between the trees, so that each tree had an irrigation channel running down 10 feet on either side of it. The black soil held water very well, and that channel was only turned on a few hours a day, according to the weather, and a little trickle was quite enough to keep trees growing well. The cotton was planted 5 feet apart in the 20 feet clearing between the rows of rubber. They might put in three rows of cotton approximately by moving the irrigation channel a little on one side of the middle, and during the first year they might have three rows of cotton perfectly straight. In the second year the rubber trees would have grown to a height of 10 or 12 feet and would shade the cotton. The trees would be—as most people knew, unless they were thumb-nail pruned or were of a spreading variety—thin tall trees, and a considerable amount of sunshine would be allowed to the crop. In the second year, therefore, they would have two rows of cotton. In the third year they would have one row, and after that the rubber trees would be too large to make it worth while growing cotton. But there was still room for other catch crops. They could grow almost anything there. Although the country was dry, the air—on the whole— was damper in the North than in the Western Province. Mannar had, for instance, an average saturation of 82. At Peradeniya, which was a rainy district, the average saturation was 78. Provided they supplied the roots with water by irrigating channels, they would do well. The air was not too dry to prevent their growth. That was the positive side of the picture.

A MALARIA DISTRICT.

The negative side was that malaria was exceedingly bad in the North-Central Province, and any one taking up land must be prepared to face a good deal of fever himself and amongst his coolies. They were in hopes that by means of that new oil method explained by Messrs. Bamber and Green, they might be able to treat the coolies in such a way as to largely prevent their getting fever. It was idle to think that the cooly would stay in a mosquito-proof house, even if they made one. The probability was he would close the curtain with care and then sit on the verandah. One must adopt something more practical to keep him clear of the mosquitoes, and he thought there might be some hope in that method of Messrs. Bamber and Green.

THE DISCUSSION.

THE NEW OIL PREVENTIVE FOR MOSQUITO MALARIA.

His Excellency:—Have you any specimens of the oil to-day?—because it would be interesting to the gentlemen present to see them. The kerosine is entirely concealed.

Dr. Willis:—Yes, I should like to call public attention to this oil method. The oil is a mixture—I forget the exact proportions—but they were given at the meeting of the Board of Agriculture a month ago. I think there were equal proportions of coconut oil and kerosene and two or three per cent of citronella with a little carbolic.

His Excellency:—Citronella?

Dr. Willis:—Yes, and a little carbolic acid. The resultant mixture has no smell of kerosene. Citronella has a very penetrating smell, and the mixture smells like weak citronella, but it does not evaporate so quickly as citronella does. It leaves no smart like citronella, and will not evaporate for at least six or seven hours. If a cooly oils himself at five o'clock in the evening he ought not to be bitten by any anopheles that night, and I think the coolies would very likely be benefited. I see Dr. Christy is present, and he will be able to speak as to that.

DR. CHRISTY ON THE SITUATION OF COOLY LINES.

Dr. Christy:—I think it is a very good plan indeed, but there are many other things which may be carried out very successfully. Still, the oil method is a very good one and ought to succeed. I have noticed on some of the plantations in Ceylon the cooly lines are very much at fault. They might be built on the high ridges with a hundred yards clear all round and away from the water. The coolies might be made to carry the water from down below. One might make the lines in fifty different ways so as to minimise the chances of getting malaria.

His Excellency:—What part of the country, Dr. Christy, have you visited?

Dr. Christy:—I have been to the Kepitigalla Valley district.

His Excellency:—I think the Public Works, as a matter of fact, have not suffered so much as they have at Maha-iluppalama with the coolies, and they attribute it to the position of their lines and to the excellence of the lines built by them. Have you heard anything about that?

Dr. Willis:—No, Sir. The coolies could have had their lines close to the bungalow, which is a mile from the Experimental Station, but every cooly is said to have preferred to go on at the Experimental Station which is six or ten feet lower than Mr. Mee's laboratory. There they can have little gardens around the house owing to the fertility of the soil. There is a good deal of malaria among the coolies down there, but on the other hand Mr. Mee suffers for several days in a month, so I am not sure that his bungalow is very much more proof against fever than the cooly lines. Of course, the fever varies with the season. Just now there is no malaria and there are no mosquitoes.

His Excellency:—Is Mr. Mee's house protected?

Dr. Willis:—No.

His Excellency:—I thought an arrangement had been made to protect it.

Dr. Willis said it was not put through, but there was a scheme for building an upstair bungalow.

MOSQUITOES AND UPSTAIR BUNGALOWS.

His Excellency:—One of the fallacies that exist is that mosquitoes will not go upstairs. (Laughter.) I am in a position to say that they do.

Mr. Carruthers:—We, in the Straits, believe that fallacy, and our lines are built on brick pillars six feet from the ground. One of the results is that the cooly uses the place underneath for his cooking, and the smoke passes through the cracks in the boards. I believe, speaking with due deference to Dr. Christy, that this has a certain effect in preventing insect pests by the smoke trickling through the room and driving the mosquitoes away.

His Excellency:—Yes, there is a good deal in that.

Dr. Willis said that in Cuba, where the coolies, though very black, dressed like white men and were of a higher class and more intelligent than the coolies in Ceylon, they lived inside protected lines.

ADMINISTRATION OF QUININE.

HIS EXCELLENCY :—Have you tried administering quinine?

Dr. WILLIS :—We use it by the hundredweight I was going to say, but at least by the 20 lb. lots.

HIS EXCELLENCY :—Do you find a good effect?

Dr. WILLIS :—It has a certain amount of good effect. Some coolies cannot stand the country. We find two kinds of coolies stand the country best—of outside coolies. The Batticaloa Moors and the Kurunegala Sinhalese stand it best. Of course, they have a fever of a very malignant type at Kurunegala. Of the local people, the women, for some reason that I do not in the least understand, are very much better than the men. We have much of our work done by women coolies. The men are emaciated and listless, but the women work fairly hard. I do not know the reason for that.

Mr. F. C. ROLES :—Might it not be because the women sleep inside and the men on the verandahs?

Dr. WILLIS :—Possibly.

HIS EXCELLENCY :—Yes, that might be the cause. I think the idea of the Medical Department at the present moment would be to combine these experiments —the administration of quinine with this anointing with oil. It will be very interesting to find that between the two the amount of sickness in the labour is materially decreased. Talking about rubber, you tell us, Dr. Willis, that the saturation of the air is greater in the Northern Province than here.

Dr. WILLIS assented.

WATER IN THE NORTH.

HIS EXCELLENCY :—Well, we have all remarked that in that dry section of the country before you come to Elephant Pass you have jungle, which, even at the end of a long drought, is perfectly green. That argues to my mind that there is a certain amount of moisture in the soil at a certain depth; and for the purpose of discovering whether that is so, a water survey is being carried out by the Survey Department. Granting that you have at a certain depth—8 to 10 feet—soil which retains the moisture, would it be sufficient to ensure the growth of rubber and its continuance through the dry weather?

Dr. WILLIS :—If the rubber got its roots down, they would be all right. Of course our experience is very limited in this district. We had rubber trees at Anuradhapura which we planted in 1894, and they grew very well up to 1898. In 1898 they would be 4 inches in diameter. Then we had a record drought. There was no water in any of the tanks, and things came to such straits that we had to lend garden coolies to help to dig wells to get drinking water for Anuradhapura, and the result was the absolute death of every rubber tree in the gardens. I imagine that, being near the ela, the roots remained near the surface. I would not recommend anybody to try rubber there without a guaranteed supply of irrigation water, and that is a bit of a difficulty at present.

HIS EXCELLENCY :—There is a large quantity of land available at Minneriya.

Dr. WILLIS :—About 15,000 acres, but it is so far away; and that is, I think, the most malarious place in the island. However, I think that difficulty can be removed. The district could be cleared of malaria, because the mosquitoes breed in the tank. Dr. Willis explained that owing to the sloping character of the bund there was a great deal of shallow water, which was saturated with mosquito larvæ; and if the bund was taken straight down, this could be obviated. There were 10,000 acres of land in that district—all of it dead flat, with good soil, reaching down to the

Mahaweliganga. He thought this was the finest piece of irrigable land in Ceylon. The tank was made and water was plentiful, and it only needed the malaria to be taken in hand.

THE NEW ANTI-MOSQUITO OIL PREPARATION.

His Excellency having asked whether there were any specimens of the oil mentioned by Dr. Willis,

Mr. Bamber said he had sent for some.

His Excellency :—It would be interesting because a large number of gentlemen, who are interested in that question, are present; and it would be well if they saw the oil and found out for themselves how agreeable the perfume of it is. When you mention coconut and kerosene, it does not sound very nice. I think this is the line upon which you will find the most effective defence against malaria.

Mr. Kelway Bamber :—I think it has to be combined with everything else that can be done.

His Excellency :—Quite so, there is another question in connection with this matter which it may be interesting to mention. Malaria is not the only thing from which coolies suffer. You know perfectly well that there has been a great deal of dysentery among coolies here and elsewhere and in other countries, and I may tell you that Mr. Martin— I was in hopes he would be here—informed me a short time ago that he had given his coolies tea. He gave them this tea morning and evening, and with most excellent effect. The reason is this. Coming lately as I have come from China, I may tell you there is hardly any dysentery there or any complaints of that kind, and it is because the people never drink cold water. They drink nothing but tea—or at least they *call* it tea. As you go along the roads in China, you see men sitting with a number of small tea cups before them and a kettle of boiling water. The tea leaves, as far as one can see, are not even withered. The man takes a few of these leaves, puts them into the kettle, fills it with boiling water, and that is what he drinks. They never drink water, and the consequence is that they never suffer from the complaints we hear so much about in Ceylon. If gentlemen, who are here so largely engaged in the production of tea, can induce their coolies to drink tea, it may have a very considerable effect. It might be worth trying. If you get four million people to drink the tea you are now sending down to the harbour, it would give you a market at your doors. (Laughter.) I mention it because it is a simple thing, and might be worth trying.

Mr. Jowitt :—It is a question of caste. A great number of coolies will not drink tea. The lowest castes will drink it, but not the high castes.

His Excellency :—That may be so. I would save the low caste coolies if I could.

After a vote of thanks to Dr. Willis the proceedings terminated.

THE LONDON RUBBER MARKET.

London, August 17.—At to-day's auction, 293 packages of Ceylon and Straits Settlements Plantation grown rubber were under offer, of which about 189 were sold. The total weight amounted to 14 tons, Ceylon contributing about 3 and Straits Settlements nearly 11. For the finer qualities generally the market was steady with a rather better tone. A particularly fine lot of large pressed Block Rubber from the Straits Settlements realised the highest price of the auction, viz., 5s. 10½d. per lb., or 1½d. over the highest price paid for Sheet or Crêpe. The lower grades again lacked attention, and the highest price paid for fine scrap was 4s. 6½d., most of this quality realising about 4s. 6d. per lb. Plantation fine to-day 5s. 9d. to 5s. 10½d., same period last year, 6s. to 6s. 3d. Plantation scrap 3s. to 4s. 6d., same period last year, 3s. 3d. to

5s. 5d. Fine hard Para (South American) 5s. 2d., same period last year, 5s. 7d. Average price of Ceylon and Straits Settlements plantation rubber.—189 packages at 5s. 3¼d. per lb., against 161 packages at 5s. 6d. per lb. at last auction. Particulars and prices as follows:—

CEYLON.

MARK.	QUANTITY, DESCRIPTION AND PRICE PER LB.
Arapolakande	6 cases fine darkish and dark biscuits, 5s. 9d.; 1 case good darkish biscuits, 5s. 8½d.; 2 cases good scrap, 4s. 3d.
Ellakande	1 do fine dark pressed crêpe, 3s. 4½d.; 1 case darkish pressed crêpe, 4s. 3½d.
Heatherley	3 do dark pressed crêpe 4s. 3½d.
Culloden	2 do dark pressed crêpe, 3s. 2¾d.
S. A. M.M. (in square)	1 do rough cloudy biscuits, 5s. 6d.; 1 case lump and scrap, 4s. 1½d.
M.A.K. (in diamond G. D.)	1 do good pale Ceara biscuits, 5s. 7d.; 1 case dark heated biscuits, 5s. 6d.
H. & C. (in diamond J. & Co.)	1 do good darkish biscuits, 5s. 8d.
Tallagalla	1 do fine dark biscuits, 5s. 9d.; 1 case fine pressed crêpe, 4s. 5d.; 1 case fine darkish biscuits, 5s. 9d.; 1 case fine pressed scrap, 4s. 6d.; 1 case barky scrap, 3s.
T.R.R.	4 do good to fine biscuits and sheet, 5s. 9d.; 1 pkge. good scrap and rejections, 4s.
Ambatenne	3 do fine palish biscuits, 5s. 9d.; 3 cases darkish, 5s. 8d.; 1 case good rejections 4s.; 1 case fine scrap, 4s. 6d.; 1 case dark, 4s. 1d.; 1 case dark barky, 3s. 3d.
Densworth	1 do good palish biscuits, 5s. 9d.; 1 bag fine to darkish biscuits, 5s. 8d.; 1 case fine pale scrap, 4s. 6d.; 1 bag low scrap, 2s. 6d.
Waharaka	2 do good palish biscuits, 5s. 9d.; 1 case good scrap 4s. 5d.
Ballacadua	3 do good palish biscuits, 5s. 9d.; 1 case darker, 5s. 8d.
Rangbodde	1 do very fine strong pale biscuits, scrap and cuttings 5s. 4d.
Duckwari	1 do fine darkish biscuits, 5s. 9d.; 1 bag fine pressed scrap, 4s. 6½d.

STRAITS SETTLEMENTS.

MARK.	QUANTITY, DESCRIPTION AND PRICE PER LB.
Gula (in diamond) V.R.Co.Ltd. Klang	2 cases fine amber sheet, 5s. 9d.
F.M.S. (in triangle)	19 do fine scored sheet, 5s. 9d.; 25 cases darker, 5s. 9d.; 7 cases fine palish pressed crêpe, part sold, 5s. 1¾d.; 14 cases good darkish, 4s. 3¾d.; 9 cases dark, 3s. 7d.
T.A.P.	1 do good thick amber sheet, 5s. 6d.
K.P.C. Ltd.	2 do good lace, 5s. 3½d.
B.R.R. & Co., Ltd.	7 do good scored sheet, 5s. 9d.; 1 case pale amber sheet, 5s. 9d.; 14 cases fine thick palish crêpe, 5s. 9d.; 3 cases darkish and dark, 3s. 9½d.; 1 case dark, 3s. 5d.; 1 case fine amber sheet, 5s. 9d.; 1 case fine darkish biscuit and sheet 5s. 8d.
C.M.R.E. Ltd.	2 cases palish crêpe, 5s. 5¼d.; 1 case very dark 3s. 6½d.; 1 case fine amber sheet, 5s. 9d.
Beverlac	5 do fine amber sheet, 5s. 9d.; 3 cases pale to dark, 5s. 8½d.; 1 case pale to darkish biscuits, 5s. 7d.
L. E. (Muar in triangle) Straits	4 do very fine large washed pressed blocks, 5s. 10½d.; 8 cases fine pale ribbon, 5s. 9d.; 2 cases good darkish, 5s.; 2 cases dark, 4s. 3d.
M.P.R.Ltd.(in cross)	6 do fine red Rambong crêpe, 4s. 1½d.

(Continued.)

MARK.	QUANTITY, DESCRIPTION AND PRICE PER LB.
M.C.I. (in diamond C. D.)	1 case good darkish biscuits, 5s. 9d.; 1 bag thick rejected biscuits, 4s. 1d.
S.P. (in circle)	1 do fine amber sheet, 5s. 9d.; 1 case small, 5s. 9d.

JAVA.

MARK.	QUANTITY. DESCRIPTION AND PRICE PER LB.
Tjidjerock	5 cases fine thick pressed sheet, 4s. 1d. bid.

London, August 31st.—At to-day's auction, 312 packages of Ceylon and Straits Settlements Plantation grown rubber were under offer, of which about 152 were sold. The total weight amounted to 15 tons, Ceylon contributing about 4 and Straits Settlements nearly 11. The finest qualities met with fair attention, though the prices offered were frequently below sellers' limits. 5s. 8d. was the ruling price for the best biscuits and sheet, and for finest crêpe about ½d. less was the current idea. Some excellently prepared rubber was shown by the Landron (Muar) Estate, and comprised 7 cases of strong pressed blocks of very pure quality. The Bukit Rajah Rubber Co. also had 16 full sized cases of choice amber crêpe, and for these 5s. 8d. was refused. Warriapolla headed the Ceylon list with a price of 5s. 8d. for a small case of well prepared pale biscuits of excellent quality. Plantation fine to-day 5s. 8d. to 5s. 9d., same period last year, 6s. to 6s. 3d. Plantation scrap 3s. to 4s. 6d., same period last year, 3s. 3d. to 5s. 5d. Fine hard Para (South American) 5s. 2d., same period last year. 5s. 7d. Average price of Ceylon and Straits Settlements, Plantation Rubber 152 packages at 5s. 1¼d. per lb., against 189 packages at 5s. 3¾d. per lb. at last auction. Particulars and prices as follows :—

CEYLON.

MARK.	QUANTITY, DESCRIPTION AND PRICE PER LB.
K. M. (in a square)	1 case good palish to darkish sheet, 5s. 7d.; 1 case good darkish biscuits, 5s. 7d.; 1 case good small biscuits, some pale, 5s. 2d.; 1 bag good clean scrap, 4s. 5d.
Palli	7 do fine palish mixed biscuits, 5s. 7d.; 2 cases fine pale biscuits, 5s. 6d.
Warriapolla	1 do well prepared choice pale biscuits, 5s. 8d.; 1 bag darker, 5s. 7½d.; 1 case similar, 5s. 7¾d.; 1 case little darker, 5s. 7¾d.; 1 bag darker, 5s. 7d.; 1 case fine pressed scrap, 4s. 5d.
Wakaraka	2 do pressed scrap, 3s. 9d.
Tallagalla	2 do strong dark biscuits, 5s. 7d.; 2 cases good pressed scrap, 4s. 5½d.
Nikakotua	3 do darkish pressed crêpe, 4s. 8¼d.; 1 case little darker, 3s. 8d.
Culloden	3 do good quality mixed colour biscuits, 5s. 7¼d.; 3 cases darkish pressed crêpe, 4s. 10d.; 1 case ditto dark, 3s. 6d.; 1 case tightly pressed dark crêpe, 3s. 5d.
Ellakande	1 do good darkish biscuits, 5s. 7¼d.; 2 cases good darkish to dark biscuits, 5s. 7d.
Tudugalla	4 do good mixed scrap, 4s. 5½d.; 2 cases black rather heated crêpe, 3s. 3d.
F. B.	1 do pressed scrap 4s. 2d.; 1 case mixed scrap and rejections, 3s. 9d.; 1 case mixed rather gritty scrap, 3s. 6d.; 1 case mixed biscuits, uneven size and colour, 5s. 6¾d.; 1 bag mixed rejections, 3s. 11½d.
Clontarf	2 do fine palish to darkish biscuits, 5s. 7½d.; 2 cases darkish to dark crêpe, 4s. 2½d.
Glanrhos	4 do good darkish to dark biscuits, 5s. 7½d.
Rangalla	1 bag mixed rejections, 3s.

STRAITS SETTLEMENTS.

MARK.		QUANTITY, DESCRIPTION AND PRICE PER LB.
B. M. P. L. (in cross)	3 cases	good palish and darkish crêpe, 5s. 6d.
L. E. (Muar in triangla) Straits	1 do	dark crêpe, 4s. 8½d.
B. R. R. Co., Ltd.	1 do	darkish crêpe, 4s. 4d.; 6 cases similar, 4s. 3d.; 1 case very dark heated crêpe, 2s. 6d.
R.R. (S. in triangle)	10 do	good strong palish sheet, 5s. 7¼d.
S.R. (S. in triangle)	9 do	mixed pressed scrap, 4s. 5d.; 3 cases darkish pressed scrap 4s. 1d.; 2 cases mixed gritty pressed scrap, 3s. 2d,
P. R. S. B.		5 cases good quality strong darkish sheet 5s. 7¼d.; 4 cases very mixed sciap, 4s. 0½d.; 1 case mixed rejections, 3s. 8d. 1 case mixed scrap and rejections, 3s. 9d.
Gula (in triangle)	3 do	fine mixed amber sheet. 5s. 7¼d.; 1 case darkish, 4s. 0½d.; 1 case mixed pressed scrap and sheet, 3s. 10½d.
S. R. & Co.	1 do	good mixed lightish crêpe, 5s, 3d.; 4 cases darkish pressed crêpe, 4s. 10d.; 1 case little darker, 4s. 10d.; 3 cases good darkish pressed crêpe, 4s. 10d.; 1 case ditto dark, 3s. 7½d.; 4 cases mixed palish and darkish pressed crêpe, 5s. 1¼d.; 3 cases good darkish pressed crêpe, 4s. 10d.; 1 case very dark ditto, slightly heated, 3s. 6d.; 7 cases darkish pressed crêpe, 4s. 10½d.
S.S.B.R. & Co., Ltd. (in triangle)	4 do	mixed pressed scrap, 4s. 5½d.
Sungei Krudda	2 do	good darkish sheet, 5s. 7½d,; 3 cases fair quality pressed scrap 4s. 5d.
Sungei Krudda S. K. S.	3 do	good darkish sheet, 5s. 7½d.; 1 case mixed rather heated scrap, 4s. 4d.

GOW, WILSON & STANTON, LTD.

London, September 14th.—At auctions the following lots comprising about 5½ tons Ceylon and about 14 tons Straits and Malay States were offered and sold as follows:—

CEYLON.

MARK		QUANTITY, DESCRIPTION AND PRICE PER LB.
Rosebury	1 bag	biscuits, mixed colours rather rough, 5s. 7d.; 1 bag fair scrap, 4s. 5½d.; 1 case barky scrap, part heated, 2s. 6d.
Ambatenne	2 cases	biscuits, fair to darkish quality, 5s, 7d.; 1 case dull unsightly biscuits, 4s. 8½d.; 1 case dark scrap, part heated, 4s. 2½d.
Sorana	1 do	fine palish biscuits, well prepared, little weak, 5s. 7d.
Waharaka	1 do	dark biscuits, very mixed, 5s. 7d.; 1 case fair brown, rather barky scrap, 4s. 3½d.
Hattangalla	1 do	brown crêpe, 4s. 9d.
Ellakande	1 do	palish biscuits, heated, 5s. 7½d.; 1 case scrap crêpe, 4s. 8½d.
Arapolakande	2 do	fair, rather mouldy, 5s. 7d.; 2 cases fair dark scrap, 4s. 6d.
Culloden	3 do	very fine pale crêpe, 5s. 7½d.; 8 cases brown crêpe, 4s. 9d.; 1 case dark crêpe, 4s. 5d.; 3 cases black chip crêpe, 3s. 9d. to 3s. 10½d.; 2 cases brown crêpe, 4s. 9d.
Nikakotua	1 do	dark biscuits, 5s. 7d,
Hapugastenne	1 do	small darkish biscuits, 5s. 7d.; 2 cases fair brown scrap and pieces, 4s. 4d.; 1 case heated, 3s.
Halgolle	1 do	pale and darkish barky scrap, 4s. 3½d.; 1 case pieces and brown scrap, 4s. 0½d.
Maddegedera	1 do	darkish scrap, 4s. 2d.
C.L. (in diamond)	8 do	fair palish scrap, 4s. 5¼d.; 1 case nuggets 3s. 8d.; 9 cases Rambong thin sheets, 4s. 5½d.
Kumbukkan	2 do	biscuits, mixed colours, 5s. 7d.

STRAITS AND MALAY STATES.

MARK.	QUANTITY, DESCRIPTION AND PRICE PER LB.		
B.N.S.S.	1	case	fair pale scrap, 4s. 5¼d.; 1 case pieces, 3s. 10d.
C.K.C. (in diamond)	2	do	biscuits, small amber cut rather short, 5s. 6½d.; 1 case dull scrap in cakes, 3s. 9d.
G.M. S.B.	1	do	scrap, 3s. 10½d.
K.P.C. Ltd.	11	do	large biscuits, fine amber (4 cases) 5s. 7¼d.; 1 case pieces and rolled lace scrap, 4s. 6½d.; 3 cases fair palish scrap, rather barky, 4s. 3¾d.; 3 cases rolled lace scrap, 4s. 6¾d.; 2 cases fair to good pale scrap, 4s. 5½d.
P.R. S.B.	10	do	pieces and scrap, 4s. 3d.
C.M.R.E. Ltd.	10	do	fine pale crêpe, mixed darkish, 5s. 6d.; 1 case ditto, inferior, 4s. 3½d.
Beverlac	4	do	fair brown scrap, 4s. 3d.
H.E.A.	1	do	pieces, 4s. 5½d.; 2 packages fair palish scrap, 4s. 4½d. to 4s. 5d.
K.M.S.	1	do	palish scrap and virgin pieces. 4s. 1¼d.
B.R.R.C. Ltd.	9	do	scrap crêpe (6 cases sold) 4s. 3½d.
Jebong	2	do	good pressed nuggety scrap, 4s. 6d.; 3 cases fair scrap, 4s. 5d.; 1 case mixed sheets, 5s. 5d.; 1 case heated and run together crêpe, 3s. 7½d.
Highland Estate	5	do	brown and black crêpe, 4s. 8½d., 7 cases scrap and chip crêpe, 4s. 5½d.

LEWIS & PEAT.

OILS AND FATS.

SCHLEICHERA OR KUSAM OIL AND FAT.

The *Schleichera trijuga*, "Kusam," or "Kusumbha," a deciduous species of the order Sapindaceæ, is a moderate-sized tree of the plains of India. It occurs throughout the dry open forests, and is sometimes met with as an avenue tree. With its thickset stem, often buttressed at the base or fluted from below the lowermost branches, and its rounded dark-green crown of leaves it is conspicuous in the midst of its many associates. On account of its tough, heavy and close-grained timber the species has been classed with the hard woods of India, the same technical properties of the product evidently also earning for the species its well-known popular name of "Ceylon Oak." So hard, indeed, is the heartwood of the kusam, that it is preferred by the natives above that of many other species for the construction of cart-wheels, plows and harrows, the handles of tools, the teeth of rakes, cogwheels for water lifts, mortars, pestles and other agricultural and domestic implements. It is usually employed in situations in which transverse pressure, shearing strain, torsion and the like have to be borne, and, were we to pronounce from its extreme durability when employed for the various purposes indicated, would appear to be eminently suited to them all. The soft yellow resin which exudes from incisions made in the bark and sapwood of the tree as well as the dye obtained from its flowers are other economic products of the kusam. Again, the lac produced by the insect known as the *Coccus lacca*, Kerr, when fed on its twigs is esteemed the finest obtainable in India.

But, perhaps, the most valuable product of the kusam is the gray vegetable fat which is deposited in abundance from its dark brown viscid oil. This oil is obtained from the kernels of the seeds that are annually yielded in large quantities. The kusam is a deciduous tree; its old leaves are shed almost all together at the approach of the hot weather toward the end of March. But early in April it again puts forth a crowded flush of new leaves which, on their elongation, are seen to be accompanied by the red tasselated flowers. These are borne upon short delicate racemes that spring from the axils of the leaves, or more usually, fasciculate in lax clusters at the terminals of the twigs and branchlets. Toward the close of the hot weather the fruits will have set, and in the middle of the rains ripen and drop. They are globular berries about half an inch in diameter of a yellowish-brown color, and are invested with a thick soft glabrous rind. On removing this rind, the smooth light-brown seed is seen enveloped in a white artistic pulp.

The latter is pleasantly sub-acid and edible and is eagerly sought after by birds and animals. It is also largely eaten by the villagers who reside within or in the vicinity of the forests in which the kusam grows. On the Malabar Coasts where it is plentiful the comminuted seeds are boiled in water, and the oil which floats on the surface of the liquid skimmed off by means of coconut shell ladles. But in the elimination of oil from the seeds of the kusam, warm expression is neither essential nor necessary, because simple cold expression itself subserves the purposes of its extraction. On crushing the kernels in an ordinary mill, a clear dark-brown oil exudes from them. It has a nutty odor and a peculiar flavor which, however, is not unpleasant, This oil, which turns thick in a few hours after keeping, deposits a dense gray butterine precipitate which remains a soft solid at ordinary temperatures. The precipitate is either stearin or palmitin, and constitutes the most valuable part of the product. Though sparingly employed in

cooking and medicine, its chief use in Malabar is for lighting purposes. Although the kusam is one of the commonest of our trees, and its oil has been known for ages in India, no endeavour seems to have been made as yet to eliminate the fat contained in it.

The species being a profuse seed bearer, thousands of tons of the fruit must now lie annually rotting upon the ground; whereas, under proper conservancy and technical manipulation much of this wastage could not only be retrieved but also made a source of wealth. During the season of mature fructescence, portable mills, if set up and worked in the localities in which the tree abounds are likely to express large quantities of the product which until recent years was believed to be the source of the Macassar oil of commerce. This famous product of the Sunda Islands is now known to be yielded by the *Cupania sideroxylon*, and though kusam fat is in consequence at present divested of the halo of romance that surrounded it. it has nevertheless to be still regarded as one of the most valuable oils of the country. As a lubricant for machinery, in the manufacture of soft soaps, but above all for lighting and candle making, the fat would appear to be deserving of application; and, although the medicinal virtues with which it is reputed to be possessed in Malabar and elsewhere await scientific inquiry and determination, its adaptability for utilization in the industrial arts is its chief recommendation to our present consideration.

[The tree is common in Ceylon, where it is known as the Ceylon Oak.—Ed.]

Photo by Ivor Etherington.

A MIXED PLANTATION: CACAO AND TEA.

EDIBLE PRODUCTS.

Cacao Cultivation in Ceylon. III.

By Herbert Wright.

(Illustrated.)

Cacao Seeds.

In shape, size, and colour the seeds vary considerably. The shape is sometimes flat as in Amelonado, Calabacillo and some forms of Nicaraguan, round and plump in forms of Caracas and Nicaraguan, long and more or less rounded in Cundeamor and other Forastero types. The size varies according to the part of the fruit occupied by the seeds, those at the ends usually being smaller—and also flatter—than those in the middle; the largest size is seen in the Nicaraguan and Caracas fruits, and the smallest in the Forastero types.

The colour of the seeds varies from white to deep purple in the same fruit or in fruits from different varieties. Generally the seeds of the Nicaraguan and Caracas varieties are white, those of the Forastero types white or purple, in varying intensity, and those of Amelonado and Calabacillo all deep purple. There is, however, a great variation in the number of white seeds in the first mentioned varieties, and more often than not the cacao trees on plantations in Ceylon possess fruits with white and purple seeds, or with all the seeds purple. It is very rare that all the seeds in the fruits from one tree are white, even with the Caracas and the more recently introduced Nicaraguan forms, and much of the unevenness in the finished product is to be attributed to this unfortunate variation.

It has been shown by Lock* that out of nearly seven hundred fruits of the Caracas variety about 58 per cent. of them possessed white seeds only, 40 per cent. possessed white and purple seeds, and 1·8 per cent. possessed purple seeds only. In the particular set of fruits referred to 84·7 per cent. of the seeds were white and 14·2 per cent. distinctly purple, thus showing that though the reputed original character still predominates, the mixed seeds are becoming very prominent. In most cacao growing countries the Cacaras or Criollo type is supposed to possess white seeds only. Similarly a large percentage of the seeds of the Nicaraguan, which are commonly supposed to be white, were found to be mixed, but the white remains predominant in some types of this group. The Forastero types always possess coloured seeds, and though as many as 18·8 per cent. of the fruits contained purple seeds only, none were seen with white seeds only; the seeds of 180 fruits of this group possessed 61·8 per cent. of purple seeds and 37·4 per cent. of white ones, thus proving the existence of a definite quantitative difference between the Forastero and the preceding Criollo types. The Amelonado and Calabacillo fruits possess 100 per cent. of purple seeds, white ones being unknown in Ceylon.

Colour of Seeds.

Variety of Cacao.	Fruits with white seeds only.	Fruits with purple seeds only.	Fruits with mixed seeds purple and white.	Percentage number of white seeds in fruits.	Percentage number of distinctly purple seeds in fruits.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Nicaraguan ...	48·2	18·8	33·0	64	36
Caracas ...	57·9	1·8	40·3	84·7	14·2
Forastero ...	00·0	18·4	81·6	37·4	61·8
Amelonado ...	00·0	100·0	00·0	00·0	100·0

*R. H. Lock, Circular, R.B.G.

According to Hart, the Criollo or Caracas variety in Trinidad possesses white or nearly colourless seeds, a feature associated with the seeds of the same variety in Java, Ceylon, and Central America, and also by the produce of *Theobroma pentagona*; reference to the percentage number of purple seeds is not made, though it may be assumed that on most estates cultivating many varieties they occur. Regarding Nicaraguan, Hart states that though the Criollo is the predominant type and the seeds are usually white in section, there appears to be a perceptible increase in the colour of the seeds and this he associates with the proximity of the Criollo with the Forastero types. The Venezuelan* cacao is mainly white-seeded and produces a cured cacao of good colour and distinct high-class flavour without any bitter taste.

The variation in thickness and weight of the seed integuments has been dealt with elsewhere, and it is only necessary to mention that the thinnest integuments are found around seeds from Nicaraguan and Caracas fruits, and the thickest in the Amelonado and Forastero types.

THE PARTS OF A CACAO BEAN, AND SEED SELECTION.

The fresh cacao seed consists of a watery white pulp on the outer surface of a tough integument, the latter enclosing two stout cotyledons which form the greater part of the embryo and are usually known as the kernel. Roughly the kernel is only responsible for half the total weight of the fresh seed, the pulp of the latter often being considerable. The weight of the seeds varies with the variety and other factors, the large plump ones being much heavier than the others. The weight of the cured seeds of different varieties is not constant, but the following table shows the average weight of several thousands of seeds of four varieties grown at the Experiment Station, Peradeniya :—

TABLE I.

Variety.	Weight in Grams.
Forastero-Cundeamor	1·01 to 1·26
Caracas	1·19 to 1·35
Amelonado	1·00 to 1·10
Nicaraguan	1·31 to 1·80

According to Semler† the following are the weights of 100 cacao beans from various countries :—

TABLE II.

Kind.	Weight in Grams.
Trinidad ordinary...	98
,, fine	123·2
,, extra-fine	178·7
Grenada fine	131·0
Caracas	130·3
Dominique	110·0
Surinam fine	122·0
Bahia	118·0
Mexican	136·5
Africa	128·5

Semler concludes that the average weight of a cacao bean is about 1·2 grams; a comparison of the weight of the seeds from varieties grown in any country should always be made. Regarding weight only, the Caracas and Nicaraguan varieties in Ceylon compare favourably, but the inferiority of the Amelonado and Forastero types is equally pronounced.

PROPORTION OF INTEGUMENTS AND KERNELS.

This is an important subject in connection with seed selection and is well worthy of consideration. The integuments of beans of the Caracas or Nicaraguan varieties are usually, but not always, thinner than those of the Amelonado or Forastero types, and the proportionate weight of

* Annual Report, Botanic Department, Trinidad, 1904.

† Le Cacaoyer, H. Jumelle, p. 40.

integument to kernel is usually lowest in the round plump samples. Actual weighings show very contradictory results owing to the variable amount of pulp, absorbed moisture, and dirt attached to the outer surface of the integument.

The following table shows the average proportionate weight of the integuments and kernels of different varieties of 100 cured cacao beans at Peradeniya:—

TABLE III.

	Weight of kernels only.	Weight of integuments.	Total weight.	Percentage weight of integuments.
Caracas	116·2 grams.	10·8 grs.	127 grs.	8·5
Forastero-Cundeamor	103·0 ,,	10·3 ,,	113·3 ,,	9·0
Amelonado	94·7 ,,	10·3 ,,	105 ,,	9·8

The integuments on badly washed or dirty beans vary considerably in weight, and in many such samples the proportionate weight of the integuments around Caracas beans is higher than that around clean beans of the Amelonado type.

According to the researches of Girard, Heisch, and Zipperer, the ratio of the weight of integuments to that of the beans from different countries is as given in the following table; the figures by Heisch are for the final product and the others for the raw beans:—

TABLE IV.

	Girard.	Zipperer.	Heisch.
Trinidad ...	9·82	... 14·68	... 15·50
Caracas ...	15·85	... 15·00	... 13·80
Puerto-Cabello ...	13·21	... 12·28	... —
Guayaquil ...	10·32	... —	... 11·50
Surinam ...	—	... 14·60	... 15·50
Para ...	10·39	... —	... 8·50
Bahia ...	—	... —	... 9·60
Ariba ...	—	... 18·68	... —
Haiti ...	8·93	... —	... —
Martinique ...	8·97	... —	... —
Cuba ...	—	... —	... 12·00
Grenada ...	—	... —	... 14·60

The Ceylon beans have been well washed and the integuments, having the minimum pulp and dirt, weigh less than other kinds; the integuments of Ceylon beans constitute from 8 to 10 % of the total weight of the cured bean.

It is obvious from the foregoing figures that in Ceylon there is a wide variation in the average weight of cured beans from fruits of different varieties, hence those with the minimum weight must either bear better cacao, be more suitable for cultivation, or give larger crops of fruit; otherwise they should be eliminated in the selection of seed parents. It has also been shown that the different varieties have constant characters in the thickness or weight of the skin, cuticle, or integument surrounding the seeds; those varieties having the larger proportion of integument are obviously inferior.

NUMBER OF SEEDS IN FRUITS.

It is now necessary for us to determine the average number of seeds per fruit and the average number of fruits borne by the different varieties.

The number of seeds per fruit varies considerably, but the following table indicates possible averages:—

TABLE V.

Variety.	Number of fruits.	Range in number of seeds per fruit.	Average number of seeds per fruit.
Amelonado ...	100	16 to 52	40·87
Caracas ...	100	16 to 42	31·45
Nicaraguan ...	175	24 to 36	28
Cundeamor ...	100	21 to 50	36·26

If the figures on tables I, III, and V. be compared, it will be noticed that the Nicaraguan and Caracas types have the heaviest seeds and lightest integuments respectively, but produce a lower average number of seeds, per fruit, than the Amelonado or Forastero-Cundeamor types. The Amelonado fruits contain the maximum number of seeds, but the latter are very light in weight and have comparatively heavy integuments. These results prove that in weight of cured cacao from 100 fruits, integuments and kernels together, the Amelonado often comes first.

TABLE VI.

Variety.	Average number of seeds per 100 fruits.	Average weight of one cured bean.	Average total weight of cured cacao from 100 fruits.
Nicaraguan ...	2,800	1·55 grs.	4,340·00 grs.
Caracas ..	3,145	1·27 ,,	3,994·15 ,,
Cundeamor ...	3,626	1·13 ,,	4,097·38 ,,
Amelonado ...	4,087	1·05 ,,	4,291·35 ,,

To complete the comparison it would be necessary to give figures illustrative of the average number of fruits annually produced on trees of the four varieties, of known age, and when cultivated under identical conditions. Unfortunately no such figures, of a reliable nature, are at present available, and we are compelled to consider only general observations on this subject. Observed trees of the Nicaraguan variety, planted in 1895, gave averages of 25, 50, and 70 fruits each in the years 1903-04; Cundeamor trees have given from 50 to nearly 200 fruits during the same period; Amelonado 30 to 90; and some trees of Caracas 30 to 50 during one year. Such figures, however, are of very little value, and our purpose can best be served by determining how many cacao fruits must be produced, per tree, to give the same weight of cacao obtainable from 100 fruits of—say, the Cundeamor type.

TABLE VII.

Var ety.	Average total weight of cured cacao, from 100 fruits.	Number of fruits required to produce cacao of weight equal to that from 100 Cundeamor fruits.
Amelonado	4,291·35 grs.	95
Cundeamor	4,097·38 ,,	100
Caracas	3,994·15 ,,	102
Nicaraguan	4,340·00 ,,	94

It may be stated that, as far as the *number* of fruits per tree, per year, from each of the above varieties is concerned, the Cundeamor and Amelonado come first, and Caracas and Nicaraguan second; this is only an approximation and does not mean that the order of productiveness of Caracas or Nicaraguan cannot be

Photo by Ivor Etherington.

CACAO TREE FROM SUCKERS.

brought very near to that of the Cundeamor by good cultivation. The highest valued cacao, by weight, is undoubtedly the large plump beans of Nicaraguan and Caracas, then the Cundeamor, and lowest the Amelonado. Judging from current values, the Nicaraguan, Caracas, Cundeamor, and Amelonado cacao may be stated to have approximate values in the ratio of 70, 65, 60, and 50. The Amelonado variety, though it is easily cultivated and gives a good crop, produces thin, flat, bitter, and deep-purple seeds, and seems to be the least desirable to cultivate.

Tobacco Cultivation in Jaffna. II.

By A. Charavanamuttu.

Diseases of Tobacco Plants.—The plants are sometimes subject to what is known in Jaffna as the 'fence' or excess of heat. It may be due to want of sufficient water to the plants and their exposure to the hot sun or to the particular condition of the soil which becomes at times overheated. The leaves of the diseased plants dry and are immediately cut and removed. There is no means of arresting the progress of it, and there is no danger also of its infection.

The leaves of tobacco plants are sometimes affected with worms called 'Alukkanavan,' 'Kottiyan,' and 'Eripulu.' They occur in all tobacco gardens in the peninsula. They appear in the early morning dew, and before this goes the cultivators are busy in searching for and killing them. Every leaf of every suspected plant will be searched in this manner. They, however, appear again and again, and the cultivators are engaged for several days in searching for and killing these worms. If not so done daily, in a fortnight a whole garden would be devastated in the manner in which large extents of paddy fields were devastated the year before last by the 'Arakkoddian' or caterpillar pest.

The 'Alukkanavan' and 'Kottiyan,' are commonly called worms by the people, but they appear to me to be merely a fungus or excrescence on the leaf of the plant. The matter is worth investigation.

Curing of Tobacco.—The leaves are cut each separately with a portion of the stem and are scattered in the garden to wither in the sun. After a few hours' withering before the leaves are dried, they are collected and heaped in a shady place. After three or four days, in which sufficient warmth is caused to the leaves, they are taken out of the heap and tied at the ends—generally five leaves together—and are hung in the ceiling of a 'kudil' to be smoked. The term 'kudil' again is applied to a mud hut with round mud walls, whose top is entirely covered with mud over the ceiling. It is protected from sun and rain by an outer roof thatched with cadjans or palmyra olas. In this hut there is a small aperture, 2×2½ feet or 2×3 feet in some cases, through which the tobacco leaves are taken in and hung under the ceiling. Through this aperture, coconut husks and similar combustibles are thrown in and burnt in order to raise a continuous smoke without creating large flames. After the leaves have been smoked in this manner, they are untied and removed and heaped together. After three or four days again the leaves are hung in the 'kudil' and smoked as before. The smoking is usually done three times, and each time the leaves are subjected to as much smoke as can be raised in a whole day. The leaves are finally hung under shelter to dry in the cool air. This is one process of curing tobacco, and is generally adopted by almost all cultivators in Jaffna.

A second process consists in merely burying the heap of withered leaves in cowdung or in pits dug for the purpose. After three or four days the leaves are removed and hung in the open air to dry. The Chutumalai and Achchelu tobacco leaves cured in this manner are considered the best for smoking.

MANUFACTURE.

Cigars.—The only manufacture is that of cigars. The process consists sometimes in rolling pieces of tobacco in a good leaf and tying the end with a thread. It is usually done by first softening the leaves with fresh water and using the first kind of leaves for the outer coating, and the second kind and pieces inside. The cigars are tied together in small bundles of ten each, and a decoction, termed (kōdā), prepared by boiling tobacco fibres in arrack toddy or young coconut water, is sprinkled over them and then they are packed in boxes. Instead of fresh water for softening the leaves first, this decoction—of a light kind—is also employed, the strong kind of it being sprinkled on cigars to impart flavour or increase the aroma which is peculiar to the Jaffna tobacco. It also serves the additional purpose of preserving the cigars from decay and damage by insects and worms.

Snuff.—A kind of snuff is also prepared by roasting tobacco leaf of the first sort and reducing it to fine powder, adding to it chunam or other substances and scents. This is used for local consumption only.

The manufactured cigars are sent to Colombo and Galle principally and are sold at varying rates, viz., Rs. 2·50, Rs. 5 and Rs. 7·50 per 1,000 according to the quality of the cigars. The best kind now in the market is Mr. M. B. Swampillai's 'Gold Medal' Jaffna cigars, which are sold at three different prices according to the size of each: Small size Rs. 10 per 1,000, medium size Rs. 15 per 1,000, large size Rs. 30 per 1,000.

The largest trade is in tobacco leaves which are exported to Travancore and Cochin in South India. The price of leaves of the first sort is between Rs. 300 and Rs. 400 per candy weighing about 600 lb., and the second kind between Rs. 150 and Rs. 200 per candy. The quantity of tobacco leaves exported during last year was 41,230 cwt. beyond sea, and 41,596 cwt. coastwise, *i.e.*, to Colombo, Galle and other places.

I give below a statement of the cost of cultivating one acre of land with tobacco and the income derivable by sale of tobacco leaves. An acre could be planted with 4,000 plants, and the cost of cultivation from start to finish, including cost of smoking and rent of land, would at a moderate rate be Rs. 384. If the crop proves the best, the leaves of the 4,000 plants would sell about Rs. 510, but an average crop may bring about Rs. 350 to Rs. 450 only.

COST OF CULTIVATION.

An acre of land can be planted with 4,000 plants:—	R.	c.
40 coolies for hoeing at 15 cents each	6	00
Penning cattle for 250 days at 16 cents per day ... ... (or at 1 cent for a plant for mannure.)	40	00
2 pairs of bulls ploughing for 4 days at 30 cents each per day ...	2	40
10 cartloads of leaves at Rs. 12·50 each	125	00
40 coolies for burying the leaves and arranging and transplanting at 15 cents	6	00
4,000 plants value at Rs. 2·50 per 1,000	10	00
Watering for 60 days—2 men at 15 cents each per day	18	00
Penning sheep among plants for manure at 1 cent a plant	40	00
Hoeing—40 coolies at 15 cents each	6	00
Tilling, weeding and making reservoirs—60 coolies at 15 cents each ...	9	00
Lopping off top of plants for a month in alternate days, 1 person for 16 days at 10 cents	1	60
Watering 4,000 plants, *i.e.*, irrigating from well—4 men at Rs. 2·50 per 1,000 plants till the leaves are cut	40	00
	304	00
Rent of land	40	00
Coconut husks &c. for smoking three times	20	00
Cooly lines and other contingent expenses	20	00
Total Expenditure ... Rs.	384	00

Generally 12 leaves are cut in a plant, and the 4,000 plants give leaves of the

1st Sort	20,000 leaves	sold generally at	Rs. 17·50	per 1,000	...	Rs.	350
2nd ,,	12,000 ,,	,, ...	,, ,, 10·00	,, ,,	...	,,	120
3rd ,,	8,000 ,,	,, ...	,, ,, 3·75	,, ,,	...	,,	30
4th ,,	8,000 ,,	,, ...	,, ,, 1·25	,, ,,	...	,,	10
				Total	...	Rs.	510

Which can be realised if the crop is successful.

CONCLUSION.

It may well be considered now in what manner the cultivator could improve his cultivation and make it a profitable concern. I have described in detail the process of cultivation, which I think can hardly be improved upon. There is little to be taught to the Jaffna cultivator, who bestows the greatest care and attention on this cultivation. But the Agricultural Society can render him assistance in other directions in which he badly needs advice and help.

First.—In the matter of *Irrigation.* This is a large question affecting not only tobacco plants but paddy plants and other plantations. There are in Jaffna no large tanks as in the Vanni for storage of water and for distribution when required. The entire supply of water is from wells, and considerable time and labour are spent in raising water. It may be good to introduce some machinery for this purpose. The 'Nona' pump tried last year at Vasarilan was found to lift too great a quantity of water at one time so as to make it useless to the cultivator, and the well ran short of its supply in a short time.

Secondly.—The *Diseases* to which the tobacco plants are occasionally subject have never been investigated, and I think it will do a deal of good to invite scientific opinion and suggestions to prevent or remedy them.

Thirdly.—As regards *Curing of Tobacco* much remains to be done in this direction. The present mode of curing is not at all satisfactory. In August last year when H. E. the Governor was in our midst, he undertook to send us a tobacco expert who would be able to instruct the cultivators how to cure their tobacco well. We have heard nothing more of it. It is perhaps our own fault. The tobacco curing season is already passing away, and we have not asked Government for the expert assistance we were most in need of.

Fourthly.—Markets for Jaffna Tobacco.—At present the sale of tobacco is almost confined to South India. It is known from existing records that Jaffna tobacco was sold in Penang, Singapore, Malacca, Java and Sumatra as long ago as the early Dutch times. If the highly pungent aroma peculiar to the Jaffna tobacco leaf were overcome by scientific curing and the leaf rendered thinner and of better flavour, I think it may fetch higher prices in markets other than Travancore and Cochin. If the product could be sent to better markets, tobacco cultivation would be found to be a very remunerative concern. At present it cannot be said to be a remunerative occupation.

Fifthly,—and the most important in my opinion, is to devise measures to save the poor cultivator from the ravages of the *local money-lender.* In Jaffna the majority of the cultivators are poor people. They get lands for cultivation on a rental of Rs. 40 per acre per annum, which they pay soon after their tobacco leaves have been sold. They want money for buying cowdung, green leaves, coconut husks, and further expenses. They usually go to the local money-lender whose trade it is to get the money immediately from the Cheddi at the usual 12 per cent interest and give to the cultivators the small sums they want, the latter agreeing to repay the money with interest at 20 per cent as soon as their tobacco leaves are sold. Oftener than not, it is the money-lender who is also the trader in tobacco. He goes to

his debtor and purchases the latter's tobacco leaves fixing his own price in many cases, and the debtor does not like to offend his creditor in the least. I merely describe what occurs in the villages. A cultivator applies for a loan of say R100 from his money-lender. The latter readily gives the money and gets a promissory note for R120 payable on demand, understanding that the amount shall be paid soon after the tobacco leaves are sold, *i.e.*, in 8 months at the most. So then the interest payable on R100 for 8 months is R20, *i.e.*, at 30 per cent per annum.

It sometimes happens that the interest is deducted from the principal, and the balance only is paid obtaining a promisory note for R100, *i.e.*, the interest payable on R80 for 8 months is R20, which is at 37½ per cent per annum,

In the first case the interest paid was at 30 per cent, and in the second case at 37½ per cent on a small capital.

This is a sad state of things which, if allowed to continue, will sap the very vitality of the poor cultivator in course of time, and the Agricultural Society should immediately undertake to prevent it as far as possible. The assistant local Secretary, Mr. Sabaratnam, once before suggested that an agricultural credit bank should be started and worked on a small scale as is done in other agricultural countries. Nothing has as yet been done in that direction. If such a bank is considered too large an undertaking, I would suggest, to begin with, at least a credit fund be raised immediately, for the present condition of the cultivators in Jaffna necessitates such a step being undertaken, and I am confident that the miserable lot of the cultivators will be improved by it.

These are merely a few suggestions which I have endeavoured to put forward in the hope that they may receive sympathetic consideration and attention.

Cultivation of the Coconut.

A Note on the Papers dealing with the Coconut Palm in the January issue of "The Philippine Journal of Science."

By C, Drieberg.

These papers on the Coconut palm are essentially studies in biology, and the details of minute experiments which are described are not such as will appeal to the mind of the practical planter. For these reasons I do not recommend that the papers should be quoted locally, at least in their entirety. There are, however, a few practical facts and deductions which I give below with a view to their being brought to the notice of coconut cultivators :—

It may almost be said that the physical character of soil is of greater importance than the chemical composition. The coconut requires a porous soil with water within easy reach of it (though, of course, not in a stagnant condition); in the absence of water the tree protects itself against injurious desiccation by a partial suspension of vitality, with a consequently reduced yield of crop. Given such a condition as is above referred to, the tree will thrive even though according to chemical analysis there is apparently not sufficient fertility in the soil to enable it to do so.

But it must be borne in mind that the roots of the coconut draw nutriment from a depth of at least 2 metres, (6½ feet) and a distance round the tree of from 3½ to 6½ metres (say an average of 5 metres, 16½ feet nearly). They, therefore, come in contact with an enormous mass of soil material and appropriate the available plant

food scattered (very sparsely it may be) through it. It thus happens that even in poor sandy soils, which are, however, porous and provided with water, there is quite enough nourishment for the tree.

Much of the food available to palms growing along the seashore is traceable to the "wash"—chiefly under ground—which comes from the land side and flows seaward. Such underground wash keeps the plants found along the seaboard in a flourishing condition, while in inland and higher situations, where the soil is less permeable, plants suffer from a lack of moisture and therefore of nourishment.

Irrigation is thus to be recommended for the latter descriptions of soils in dry seasons; and the use of manures, particularly those furnishing mineral food, are likely to be repaid in an increased yield.

To put the matter shortly: on a loose soil where water is at hand, the roots travel about freely and find plant food which is then absorbed in the form of very dilute solutions. In higher and drier land where the soil is of a firmer texture the tree is less able to forage for itself owing to soil resistance and paucity of water. The proportion of mineral food taken up may be said to be proportional to the amount of water absorbed.

It will thus be seen that it would be a manifest advantage to increase the transpiration in the plant, and so also increase the absorption of water and mineral food.

This may be done in two ways—

(1) by increasing the amount of water at the disposal of the roots.

(2) by improving the conditions for evaporation through the leaves.

Judicious irrigation will bring about the first, but the soil must not be allowed to become "logged."

For the second there should be ample sunlight and "wind." Provided the roots are not too dry, the more the tree is exposed to these forces the better for it. *To this end avoid close planting.* It may be generally stated that the further apart the trees are planted the better they will thrive. Certainly up to 15 metres (50 feet nearly) any increase will appreciably increase the yield. It is the interlacing of roots and leaves, and the competition among trees for air and water that reduces their yield. The best ordinary distance is 9 metres (30 feet nearly). It is only in exposed situations, or where intensive cultivation can be economically carried on that this distance may be reduced.

The reason why trees thrive along the seaboard is attributable to the fact that their roots are able to stand the action of concentrated solutions (*e.g.*, sea water) and the leaves delight in sunlight and wind. As with other plants it is possible to create artificial conditions as favourable, if not more so, to crop production. But the conditions referred to above must be provided even in the richest soils for the best results, viz., sunlight, water, and wind; for a lack of light, a restricted supply of water, and a still atmosphere, are unfavourable to the coconut.

In selecting nuts, they should be taken from a tree in which the productive power is great in proportion to its opportunities, *i.e.*, one that bears a proportionately larger number of nuts than its neighbours. It is a mistake to select nuts from trees which are equally prolific in a given area. Heredity (individual character) rather than environment should be looked at in this matter.

Though we would not expect to find it so, both chlorine and common salt may be said, from the insignificant quantities in which they are found, to be negligible elements in the food of the palm. According to analytical results it is found that there is a gradual increase in the proportion of meat (kernel), copra, and oil (with a decrease of milk, indicating that the meat becomes firmer, loses water and gains oil)

as the nut increases in age up to three months of storing, *i.e.*, when they are beginning to sprout. In nuts kept for six months, though the meat is practically the same, there is a marked decrease in the proportion of copra and oil, due to decomposition or other causes. Thus both in very fresh and in over-ripe nuts there is a considerable deficiency in oil.

In planting in the nursery the practice in the Philippines appears to be to cut a small section of the husk off the top of the nut to afford more easy egress for the sprout.

As a protection against wild pig, a pit 4 or 5 feet deep is dug and the nuts planted at the bottom.

"Grill-dried" copra is not so liable to be attacked by insects and moulds, though it is considered inferior owing to its dark colour and smoky flavour.

VANILLA INDUSTRY IN THE SEYCHELLES.

A British Colonial Office report for 1905 on the trade of the Seychelles Islands gives the following particulars of the vanilla industry :—

EXPORTS OF VANILLA.

	1904. Rs.	1905. Rs.
United Kingdom ...	130,592	137,185
France	148,446	136,462
Mauritius	8,987	64
Switzerland	8,400	8,400
Germany	—	765

The striking feature in the foregoing statement is the continued collapse of vanilla, the staple export of the Colony for many years. Vanilla may have a future; in no place are the conditions of nature more favourable than in Seychelles, but for the present it is of little value, and the crop of 1906 is so small that it cannot be expected to exceed 20,000 kilos. Vanilla has long held the pride of place at the head of the products of Seychelles. In 1905, it has been displaced by coconut products, which have been exported to the value of Rs. 413,951, whereas vanilla has fallen in value to Rs. 282,876. The quantity exported was more than anticipated, being 48,208 kilos., or over 100,000 lbs., but the actual crop did not exceed 36,000 kilos., the surplus consisting of the balance of the crops of 1903 and 1904, which had been held up for better prices. The crop for 1906 will not exceed 20,000 kilos., and there is only a very small stock of old vanilla held locally. The cause of the falling-off in crops in 1904, 1905, and 1906 is the period of drought in 1904, which destroyed one-third of the vines and reduced the vitality of the remainder. The crop of 1904 had been expected, judging from the flowering season of 1903, to be normal, viz., 60,000 kilos., but in consequence of the drought it reached 45,000 kilos only. The drought of 1904 checked the flowering for 1905, and a crop of 36,000 kilos. was the result. A repetition of the period of drought in 1905 led to an almost complete failure of the flowering season for the crop of 1906, when the total amount cured will not exceed one-third of an average crop, and will be as small as that for 1900, without the saving grace of high prices. Favourable weather in 1906 promises a good flowering season for the crop of 1907; the vines are in good heart, and it is probable that—as far as a forecast is possible—the crop should be up to 50,000 kilos.

What the failure of the vanilla means to Seychelles may be illustrated by the fact that, for the term of ten years before 1904, the average crop represented an output of 38,476 kilos., valued at Rs. 714,096, and selling at an average price of Rs. 17·95 per kilo. In 1905, the export of vanilla was valued at Rs. 282,876, with an average price of Rs. 5·87 per kilo. And the failure means more than this, for planters had been living on a scale commensurate with their recent good fortune,

and traders had been accorded credit on a similar scale. Credit ceased suddenly, and advances on crops and on mortage were called in, and no banking institution existed to help those planters who held valuable properties, but lacked, for the moment, means to keep them in cultivation or to supplement their resources by the introduction of new products. At this juncture the Government, being supported on the authority of the Secretary of State by a credit with the Crown agents, was enabled, under the provisions of Ordinance No. 4 of 1904, to advance to approved planters, on the security of first mortgage, sums not to exceed Rs. 100,000 in the aggregate. These loans have saved many planters from bankruptcy, and staved off the abandonment of cultivation on several valuable properties. The amount actually lent at the close of 1905 was Rs. 67,800, when the further operation of the Ordinance had to be suspended. Although the vanilla crop for 1906 is again a failure, there has been a resolute effort on all sides to improve coconut cultivation, and to develop new industries, especially rubber cultivation; so the prospects for 1907 are more generally hopeful than for three years past.

A statement showing the value, quantity, and average price of Seychelles vanilla for the last 11 years is attached:—

Year.	Quantity of vanilla exported.	Declared value of vanilla.	Average price per kilo. of vanilla.	
	Kilos.	Rupees.	Rs.	cts.
1895 ...	4,553	60,344	13	25
1896 ...	31,227	936,000	29	97
1897 ...	30,691	920,730	30	00
1898 ...	25,177	748,810	29	74
1899 ...	41,835	1,338,720	32	00
1900 ...	17,569	580,877	33	06
1901 ...	71,899	1,108,792	15	42
1902 ...	60,862	642,331	10	55
1903 ...	59,784	503,994	8	43
1904 ..	41,072	300,026	7	30
1905 ...	48,208	282,876	5	87

The quantity of vanilla cleared for London in 1905 was 22,566 kilos., valued at Rs. 137,185; the proportion of the crop and the total value being much as in 1904. London is looked upon as the better market when prices are good, but Paris sales are steadier when demand is dull; that conclusion is based on the fact that there are regular monthly sales in London where parcels are sometimes put up for forced sale; whereas in Paris there is no open market, but the principal buyers, having standing contracts with the wholesale consumers, are ready to buy at a figure which is not subject to market fluctuations. As the price ruled uniformly low during 1905, the proportion sent to London was no more than 46 per cent. of the total; in prosperous years the proportion sent to London has been as high as two-thirds. The exports of vanilla to Paris included more than half the crop (24,757 kilos.), valued at Rs. 136,462.

The report by the Curator of the Botanic Station for the year 1905 states that the rainfall during 1905 was unfortunately distributed and the vanilla crop for 1906 will be considerably reduced. The weather was very promising until the end of July, but the rain fell abundantly in August and September, and the vanilla vines put forth new growth instead of flowering. Orange and lime trees should be planted on a much greater scale than they are at present for exportation as fruits, and for the production of citrate of lime. In short, the climate of Seychelles is highly benefical to the growth of citrus trees, and better attention should be paid to them. Citrate of lime is imported into the United Kingdom to the amount of 1,400 tons annually, and a Seychelles planter has succeeded in making a sample of citrate containing 65 per cent. citric acid. The lime industries are

specially adapted to Seychelles labour and to the shipping difficulties of the Colony, and there is also a certain amount of profit to be derived from them by the production of hand-press oils (worth 3*s.* 6*d.* on the London market). The future of this Colony lies in tree planting on a greater scale than it is at present, and not in cultivating herbaceous plants which are so susceptible to climatic variations.

Owing to the fall in the price of vanilla, the Curator was asked to prepare an extract from inferior vanilla in order to try to avoid exporting low-grade beans as such. The experiments are not yet completed, and the extracts will soon be forwarded to the Imperial Institute for valuation. A simple maceration of 400 grammes of vanilla in four litres of alcohol is not sufficient, and the *modus operandi* which has given the best results is the following:—The vases containing vanilla arranged in the form of a battery and alcohol at 80° to 85° allowed to remain one week in one vase before being transferred to the next containing fresh vanilla. A sort of diffusion is then practised until the four or six vases have received the alcoholic solution four or six times each.

CARDAMOMS IN THE SEYCHELLES.

In July a lecture was given in the Council Chamber of the Seychelles Government, and presided over by His Excellency the Governor, the subject being the Culture and Preparation of Cardamoms. This meeting was attended by forty persons, including the leading members of the community.

The great analogy between Ceylon cardamoms and the Seychelles "longouze" (*Amomum Daniellii*, Hook.) was pointed out, and specimens exhibited. The numerous ravines in which the "longouze" grows wild, and many other similar localities were described as being very suitable to Ceylon cardamoms on account of the protection from the wind and the presence of proper shade trees. Shade and protection from the wind were shown to be the only factors worth considering, all the other climatic and agrologic conditions of the Seychelles mountains being identical with those of Ceylon.

The numerous uses to which cardamoms are put in India and Europe were enumerated, and the methods of cultivation and preparation were treated in detail. The analogy between vanilla and cardamom preparation was insisted upon, and the fact emphasised that the crop of one plant followed that of the other. The cardamom seeds brought from Ceylon in February, 1903, were sown at the Botanic Station, the seedlings nursed until November, and then planted out at Capucin Crown Land. The plants were grown in poor laterite soil under shade of eriodendron and spathodea. The first flowers appeared in July, 1905, and the first ripe fruits were gathered in December, 1905. The Malabar variety ripened a few weeks earlier than the Mysore variety. Three planters applied after the meeting for cardamom plants, and all the suckers that could be disposed of, viz., 1,000 were sold during 1905. It was ascertained that Indian cardamoms were sold at Rs. 2·50 a lb. on the local market, and that the whole Seychelles crop could be consumed locally or exported to Mauritius and South Africa, thus ensuring the possibility of establishing a secondary industry of some value in this Colony. The ravines where cardamoms should be planted are not occupied by other plants, and those planters who have gone in for the new product have reported favourably on the growth of the suckers which they had purchased.

The cardamom plant makes good growth in the highlands of Seychelles, and in the experimental plantations at Capucin the first crop was obtained twenty-six months after planting. As stated in other parts of this report, this spice, if produced in this Colony, can be consumed locally and exported to Mauritius and to those parts of Africa near Seychelles, where Indians bulk considerably in the population.

MISCELLANEOUS.

Notes on Methods of Irrigation in Arizona. II.

By J. H. W. Park.

The object of the whole method of irrigation is to get as much water to pass through the plants as possible, and to let as little of it as possible escape by seepage and evaporation. The distribution of the water through the furrows only, and not over the surface of the land, and the cultivation of the soil close the latter means of escape, and it is assumed that the water so caught in the soil is retained there to be extracted by the plants as they require it.

There does not appear to be much doubt of the efficiency of the method. The retention of the water in the soil is shown by the following table taken from a report by the Professor of Agriculture in the University of Arizona, which gives the percentage of water present in the upper five feet of the soil of two fields eighty days after irrigation, the surface of one field having been cultivated and the surface of the other having been left to dry without cultivation :—

	Cultivated.		Uncultivated.
First foot, moisture %	7·3	...	3·8
Second ,, ,,	12·6	...	8·1
Third ,, ,,	15·6	...	10·5
Fourth ,, ,,	15·0	...	11·6
Fifth ,, ,,	12·1	...	11·7
Total ...	62·6		45·7

In this case the cultivated portion contained some thirty-three per cent more water than the uncultivated portion, or roughly some two and one-half inches of water over the whole area, and when it is remembered that the whole of the moisture stored in the soil is not available for the support of plants, the advantages of cultivation in retaining water in the soil which is so available becomes very evident.

As noted in the case given above a particular farmer received water for 2½ days out of every eleven. It must not, however, be supposed that he watered the whole of his crops once every eleven days ; on the contrary he turned the supply to a portion of his crops only, and the remainder went without water for a much longer period, although the length of the period depended upon the nature of the crops.

Crops Raised.—The whole method of irrigation may be illustrated by the following notes on some of the different kinds of crops raised and on the irrigation of them.

Egyptian Cotton.—Seven-tenths of a foot of water applied to land before planting, planted in rows with furrows three feet apart, irrigated thirteen times in 186 days with a total depth of water of five feet. Yield 400 lbs, per acre.

Melons.—Seven-tenths of a foot of water applied before planting. Planted in rows on the edge of the furrows which were eight feet apart, so that the roots are watered from the furrows and the plants grow on the ground between them. Irrigated twelve times in 114 days, total depth of water used 3·3 feet. Yield 27,000 lbs, per acre.

Wheat.—Sixth-tenths of a foot of water applied before planting. Seed sown broadcast and the field furrowed two feet apart, the soil from the furrows being turned over on the seed-forming plots of about 15 inches wide. No irrigation is

necessary for the first two months, by which time the crop is well up and protects the soil from the sun and reduces evaporation from it. Three irrigations given in the last thirty days of the growth of the crops and the total water used was 2·2 feet deep with a yield of 2,150 lb. per acre.

Peaches and Apricots,—These are planted in rows of about 15 feet apart with furrows between from which the water is run to the root of the tree. Water is given while the tree is dormant above ground, ten irrigations being given in 75 days, and then the supply of water is stopped until the fruit forms when water is again occasionally given. The total depth of water used was 3·8 feet for peaches and 5 feet for apricots, and the yield 4,400 lbs. and 7,600 lbs. per acre respectively.

Tomatoes.—For these the furrows were 4 feet apart. The seed was planted along the edges of the furrows. Six-tenths of a foot of water were given before sowing. The seeds were irrigated two days after planting, twenty-seven irrigations were given in 244 days, the total water used was 4·3 feet per acre, and the yield 12,300 lbs. per acre.

Indian Corn.—Six-tenths of a foot of water was applied previous to planting, which was done in rows along furrows previously moistened. Five irrigations were given in thirty days, the total depth of water used being 1·5 feet. Water was used while the corn was growing and not after the ear had begun to form.

General Remarks.—From the above it will be seen that in a country much drier than Ceylon it has been found possible to raise crops of an extremely varied character by the use of a quantity of water seldom exceeding one acre foot per acre of crops raised per month of their growth.

As already pointed out, the evaporation from a water surface in the district is 80 inches per annum, or over six inches per month, and it must be clear that by the use of furrows which present only a small surface in comparison to the area cultivated, the loss by evaporation must be reduced far below the loss which would occur if cultivation by flooding were practised.

Anomalous as it may seem, the efficiency is to some extent also due to the extreme dryness of the climate. Rain is infrequent with the result that the soil once cultivated remains dry on the surface, and the water once caught beneath that surface is not easily evaporated.

The writer does not think it can be doubted that the main reason for the efficiency of the system lies in the use of the furrows, and the extra attention which their use demands in the distribution of the water passed into them from point to point of the fields under cultivation, and that the cultivation of the ground in the furrow is important as a means of increasing the efficiency.

Possibility of Applying the Method to Ceylon.—The writer thinks the system should be applicable to various crops in many parts of Ceylon, in spite of the fact that the rainfall is much heavier and the necessary dryness of the surface soil more difficult to obtain.

It will probably be stated that the only known crop grown under irrigation in Ceylon is rice, and that for this crop the furrow method of irrigation is not suitable. This may be true, at least the writer is not aware that any attempt to grow rice by the furrow method has ever been tried, although the growth of crops such as wheat and alfalfa would point to the possibility of doing so.

With the abundant rainfall of the N. E. Monsoon, the writer sees no reason why the method of growing rice by flooding should be abandoned but that crop should be grown during the N. E. Monsoon only, and due care should be taken to use the irrigation water to supplement and not to replace the rainfall. For this purpose the land should be ploughed dry at the commencement of the Monsoon, and then sown

and watered heavily by irrigation only after the seed has sprouted and is well up. This is the system practised largely in Texas, and it is not altogether unknown in Ceylon, as in the Jaffna Peninsula the land is often ploughed dry and sown and the crop is grown under rainfall alone.

It is during the dry weather of the S. W. Monsoon that the writer believes the method of furrow irrigation could be adopted, possibly in the paddy fields themselves, for the production of those crops which are now usually grown in chenas, of which, so far as he can discover, all would be much better raised under properly regulated irrigation than on high lands under an uncertain rainfall. Quite recently he saw an excellent chena crop sown on land which had been cleared for aswedumization, and which would have perished owing to lack of rainfall, saved by irrigation, and the only reason the owners were able to give for not regularly growing such crops in this manner was that they preferred to grow paddy on the land by irrigation after the rains had practically ceased.

With the saving of water which would follow in the N. E. Monsoon by dry ploughing and proper utilization of rainfall, and the further saving due to furrow irrigation in the S. W., it should be an easy matter to double the area of crops grown while the change in the nature of the crops, if the same land was cultivated twice yearly, should be of advantage to the land.

In support of the contention that furrow irrigation can be used in Ceylon, the writer would point to the extreme dryness of certain months of the year in certain parts of the Northern, North-Central, North-Western, Uva and Southern Provinces. Thus the average rainfall of June, July and August has been at Mannar 1·33″, Anuradhapura 4·28″, Puttalam 3·07″ all for 34 years, at Alutnuwara it has been 2·68 for 6 years, and at Tissa, S. P., 2·87 for 31 years, and many other examples can be found. The losses by evaporation are not so well known, but Mr. Parker made it 68″, at Giant's Tank, the writer found a loss of 58 inches had occurred at Horabora in 1904, and he has been informed the loss was 72 inches last year at Kalawewa.

Under these circumstances he cannot but think that furrow irrigation and cultivation of the land thereafter is possible, and that the question of the method of irrigation used in Ceylon with the proper time for sowing paddy is one worthy of more attention than it has received.

Agricultural Banks for Ceylon.—III,

By E. S. W. Senathi-Raja.

Funds.—The great success of the Scotch Banks, as we have seen, depended on their issue of bank notes. Several schemes were started in France, inspired by the remarkable success of the Scotch banks, to issue paper money, but they ended in disastrous failures. It was soon perceived, however, that the success of the Scotch banks was chiefly due to prudence of administration and to the suitability of the system to the conditions of Scotland and the national characteristics of its people. The issue of bank notes, it was found, was a convenience and an economy rather than a source of funds. Hence the issue of bank notes has not been received with favour on the European continent, and only a few land banks have the right to issue paper money. In France there is none entitled to do that. The rarity of this privilege shows that it is not generally feasible. There is, however, another great and unfailing source of funds in all the continental land banks, and that is the interest bearing mortgage-debentures (Pfandorief, obligation foncière). In its original form, when it was brought into use in the 18th Century, the debenture was merely a bond for an amount from four to twenty pounds,

given by a bank to a borrower on payment of a mortgage bond executed by him. It expressly indicated the property mortgaged, and the property alone was the material guarantee for the specific bond. The bank was only an intermediary between a borrower and lender, who were in direct relation with each other, and the bank merely gave its guarantee that the mortgage was a good one, and that payments would be duly made. The lender received the debentures from the bank, sold them in the market and converted them to money. The lender looked to the borrower for principal and interest, and not to the bank which only took proceedings against the borrower in case of non-payment. This, of course, was a great advance from the mere private system of mortgage. The man who had money to invest, had only to buy the bonds in the market, without making any enquiry as to the value of the property mortgaged or the validity of its title. He had the guarantee of the Land Bank which was liable in the property of all its members for the guarantee. If the mortgager failed to pay up, the lender was paid by the bank. If the lender wanted the money at any particular time or for any emergency he could sell his bonds in the market, thus transferring his debt to another creditor. This took place without any expense save brokerage, if any. If it was a case of private mortgage, where the mortgagee wanted money immediately, the mortgager must make a diligent search for another mortgagee and transfer his mortgage to him provided he succeeded in finding one. Even then he had to incur further heavy expenses for notarial fees, stamps and registration. Moreover, the holder of bank debentures need only sell so many only as he finds necessary to do—the debentures being usually bonds for small sums—whereas a mortgagee must transfer the whole debt or nothing.

Hence the debentures of Landschaften became current stock which very soon rose to its par value and maintained its value even in the worst times. The borrower himself had loans for long terms without fear of foreclosure so long as he paid his dues. He could get as large a loan as he wished on a primary mortgage to the land bank instead of giving to two or three lenders, and borrowing money on secondary and tertiary mortgages and incurring heavy expenses. In course of time, however, a further modification was made in the form of debentures—a modification which has greatly enhanced the usefulness of debentures. The modification is this, viz., the bank issued its debentures in its own name without specifying any particular property as security. There were two advantages in this change. First, the buyers of the new bonds became creditors not of any particular individual but of the bank, and their security was not any particular property, but the whole mass of the security held by the bank, plus the bank itself. Secondly, the debtors found it possible to reduce their capital liability, by payment of a small percentage in the shape of a sinking fund. Under the old system of debentures this was impossible, as the debtors made their periodic payments of interest not to the bank itself but directly to their creditors, and no creditor would receive his principal by petty sums spread over many years. These new debentures, generally payable to bearer or to order, are those now in universal use on the Continent, and funds to any required extent could be raised by this issue. Indeed, under this system of debentures all immovable property may now be said to be capable of being mobilized. The landed property of a whole country may thus circulate in the market in the form of debenture bonds. The Credit Foncier de France issues its debentures in masses of ten millions to thirty-six millions of pounds sterling, the plan adopted being to divide them into numerous series, and issue them by series as soon as loans have been effected to the value of a series. For example, in 1879 a loan of thirty-six million pounds was sanctioned and divided into 180 series, each consisting of 10,000 bonds and making a total of 1,800,000 bonds. Each of the series of 10,000 bonds was of the nominal value of £200,000. In

most cases these debentures, though issued for sums from twenty pounds and upwards, are subdivided into detachable *coupure* (or slips) of £4 or £5, so that even poor persons may invest their savings in them.

All debentures are repayable as the mortgages are redeemed. The capital repaid by borrowers is followed by a redemption of the debentures of that series. These are not repaid according to their consecutive numbers, but the numbers to be paid off are determined by lot. By this means bonds are kept up to their par value, and each bond is payable at par. Thus, if a three per cent is issued at £85, its market value immediately rises, for there is a chance of its being drawn at once and the holder will get repayment at par, that is, he will receive £100 for the £85 that he paid. There is the further advantage that a certain number of these bonds get large lottery prizes at the periodic drawings. Thus in the loan of £36,000,000 raised by the Credit Foncier in 1879, the 1,800,000 bonds which were issued were repayable within 60 years by six annual drawings. On an average therefore thirty thousand bonds worth £600,000 are repaid every year at par, and of these 600 bonds get prizes worth £86,000, every year.

The debenture-holders cannot demand payment until their bonds are drawn, but they may sell them in the market at the current price. The bank pays its debts by these ordinary drawings, and sometimes when mortgages are paid in advance by special drawings. The rule which is strictly observed in regard to all debentures is *that there must be an equilibrium between the debentures and the mortgage-securities.* The reason is that if the debentures are not paid off, as the mortgages are redeemed, then some of the bonds would not be covered by mortgage securities, and therefore there would not be that double guarantee of the mortgages and of the shareholders which makes the position of these banks so exceptionally strong. Certain legal privileges are attached to these debenture bonds. In France holders in due course are entitled to payment of their value or interest as the case may be, and no court can attach those sums. They are also authorised to be admitted as securities in which trust moneys may be invested. They have also certain fiscal privileges in regard to stamps, registration and transfer duties. The debentures it will be seen are an invention which is at once most ingenious and fruitful in results, and it is pregnant with vast possibilities for our country. The system of issuing debentures makes it possible even for a poor country like Ceylon to find within its own limits all the capital necessary for its development. A land bank in Ceylon founded under the most favourable conditions, that is to say under the auspices of the Agricultural Society with the guarantee and supervision of Government, will at once raise the confidence of the public, and its debenture-bonds will draw all the petty hoards from every part of the country into the coffers of the land bank. They will afford the best and safest investments for savings, and by the adoption of the French method of sub-dividing the bonds into *coupures,* they may be brought within the reach of all who have any savings large or small to invest. They will add to the currency of the country, for these bonds will pass by delivery or endorsement. There will be neither legal nor fiscal expenses in the transfers. Money is placed with the bank which gives in return an interest-bearing receipt. The holder of the receipt gets the interest periodically, and his capital at the time when the bond may fall due or at the periodic drawings. But it is easily convertible into ready money by delivery or endorsement. For borrowers these debentures offer advantages which no other system can do. As the debentures are issued at the same time as the loans are contracted, the loans may be granted for as long a time as is necessary for the borrower without fear of unduly locking up capital. By the method of a sinking fund, it affords an easy method of paying off almost imperceptibly the capital debt. The sinking fund consists of small annual pay-

ments included in the fixed annuity. The annuity remains fixed, and as the portion due to interest gradually decreases, the one allotted to sinking fund increases. Here lies the great advantage to a borrower of borrowing from a land bank, instead of borrowing from private lenders. A private lender cannot and will not receive his loan back in small payments spread over many years. When the term of the mortgage is over the whole loan must be repaid. This can only be done by further borrowing which will lead to more debt. It is a well-known fact that capital sunk in the purchase or improvement of land can only be replaced by setting apart annually a portion of the income. The founders of the Credit Foncier de France seem to have clearly apprehended this fact. The reports show that one-half of all the loans granted by the Bank bear annuities in which the payment for the sinking fund is so small as to be hardly distinguishable. For instance, if a man borrows a sum of ten thousand rupees from the Bank for fifty years, he pays an annuity of Rs. 5·72 per cent. to the Bank of which Rs. 5·30 goes for interest and only 42 cents for the sinking fund. He will pay annually Rs. 572, and at the end of fifty years Rs. 28,600, and the annual payment of Rs. 572 on which compound interest is calculated for fifty years wipes off both principal and interest. If he borrowed the sum from a private lender at the same rate of interest for fifty years, he would pay during the fifty years Rs. 26,500 as interest alone, and still owe him the capital of ten thousand rupees. This is due to the fact that as the sinking fund accumulates at compound interest, the principal debt gradually decreases, while the annuity remains constant. The result is that the portion of the annuity due to interest decreases and the portion credited to the sinking fund increases, so that at the end of the payment the sinking fund becomes 5·15 per cent. and at the end of forty years 3·28 per cent. It may be added that on the continent of Europe in almost every country all loans on the security of land are repayable only by annuity.

The foregoing summary of facts collected from various sources will be sufficient, it is believed, to give one an idea of how land banks have been found necessary for the advancement of agriculture in different countries of Europe at certain periods of their economic progress, and how the problem has been solved by them. It has been suggested in some quarters that voluntary societies and popular banks like the Schulze Delitzsch in Germany and Raiffeisen in Wurtemburg will answer our purpose in Ceylon. But the condition of our society is not advanced enough for the formation and working of such voluntary societies. Even on the European continent where they have been founded, they are institutions of but recent growth, whereas the land banks have been in existence for more than 150 years. State aided land banks must precede, and their utility and success serve as an object lesson to the natives, before any popular banks either urban or rural can be started with any advantage to the public. The foundation of such institutions which cannot but be ephemeral in the present state of our economic progress, will, instead of helping the people, prove to be a national disaster by utterly ruining the organisation of credit. Co-operative credit societies have been in existence in India for nearly ten years, and what is the result? Mushroom societies have come into existence by hundreds, and have perished with equal rapidity, and there are others which are eking out a miserable existence and are on the verge of extinction. And yet India is far more advanced than Ceylon in the organisation of credit, for there are classes and castes of bankers like the Gomutte Chetties, Bamas and Natucotta Chetties, who for generations have been engaged in banking, while in Ceylon we have no such organisation. The co-operative credit societies which seem to be fairly successful are very small ones with a capital of Rs. 300 or Rs. 400 established in villages where people are known to each other. It is hardly necessary to add that it will be impossible to develop the agricultural resources of Ceylon with the aid of such miniature societies alone.

The most remarkable feature in the land banks, on the continent of Europe, it is to be observed, is the impulse given to them by the governments of the different States of Europe, almost every land bank having been founded by the initiative of the Government, and placed under its direct control and supervision. In Ceylon, too, it cannot be denied that we have arrived at such a state of economic progress, that for the further development of agriculture, some institution in the nature of those land banks has become absolutely necessary. More than a hundred years have passed since the British occupation of the island, and more than three-fourths of the country is yet in a condition of waste or uncultivated land. Even in districts where forests have been cut down and lands opened up for coconut cultivation most of the native agriculturists are in great straits. By the time the coconut estates come into bearing the proprietor gets into the clutches of the Natucotta Chetty or other money lender, and not infrequently the estates pass into the hands of strangers.

The cultivation of coffee, tea, cocoa and other new products by Europeans in the higher altitudes of Ceylon has only been found possible with imported capital. If not for the introduction of that capital, it need scarcely be added that agriculture in Ceylon would be in the most backward condition. But the native agriculturists and land-owners have not the same advantage of invoking the aid of European capital in time of pressure, except on rare occasions with the help of middle men and under onerous conditions. The time is ripe therefore, it is submitted, that the Government of Ceylon should come to the aid of the people, by founding land banks under the auspices of the Agricultural Society. Unlike European States, many of which are getting more and more dependent on their manufactures and industries, Ceylon is a purely agricultural country, which for years to come must have agriculture for its mainstay. If Government initiative and assistance were found indispensable to give birth and stability to the land banks of the great, independent and highly civilised states of Europe, it needs no argument to prove that it would be impossible to establish such institutions in Ceylon or to ensure their success, without the support, encouragement and control of the Govern ment. The land banks, it is to be remembered, should be dependent for their success on the confidence which they inspire, so that their bonds may circulate in the market with the same facility as currency notes of the Government, and such a result can never be achieved without Government connection.

As for the funds, there is every reason to believe that all the monies requisite for founding a land bank in Ceylon with branches in various districts can be raised in Ceylon by means of that most valuable instrument known to European land banks as debentures. When it is once known to the local public that the debentures of a land bank are issued under the control and supervision of the Government of Ceylon, and that they may be bought and sold and readily converted into money in the open market, there can be no doubt that most of those who have savings, even small savings, will invest their monies in them. That there are considerable savings in the country available for a land bank may be inferred to a certain extent from the funds that are invested in mortgages in Ceylon. According to the statistics furnished by the Registrar General, the amount of money secured by registered mortgages in 1897 was Rs. 45,918,796; in 1898 Rs. 40,376,729, and in 1903 Rs. 23,097,180.

As for the means to carry on the work of the land banks in Ceylon, we have a ready made machinery in each province in the Government Agents and their Assistants, with all their subordinate staff formerly employed in the collection of paddy and grain taxes. The various Kachcheries may be utilized for keeping the funds, and the revenue officers of the Government may be trusted for investigating the title and appraising the value of the lands to be mortgaged as security for the loans. Some special legislation will be necessary for the prompt

and speedy recovery of interest from debtors, and even there we have a precedent in the summary methods employed for recovering grain taxes before they were abolished. As in the case of the German Landschaften and the Credit Foncier de France, special privileges should be granted to the land banks, enabling them, for instance, to recover all dues as first charge on the property of the debtor. The provisions necessary to protect the land banks and to establish public confidence in their stability are mere matters of detail which may be embodied in an Ordinance.

In connection with the land banks, and as an auxilliary to them, it will be easy enough to establish, and there ought to be established, co-operative credit societies in each large village as those founded in India. The Government of India has enacted a special law in Act X of 1904, to facilitate the formation of such societies, and the Ceylon Government may follow in the wake of its big neighbour by introducing similar legislation. Those societies will help the small village farmers, artisans and labourers. Thus with a central bank in Colombo, and branches in each province under the control and supervision of the Government, and with village co-operative credit societies the organisation of credit in Ceylon will be complete, and then there will be no reason why agriculture in Ceylon should not make as rapid progress and on modern scientific lines as it has done in Europe and America. Without such a comprehensive system of land banks and co-operative credit societies including the entire organisation of credit, the mere foundation of petty co-operative credit societies alone will be impracticable, and can never effectually advance the progress of agriculture in Ceylon.

Finally, the present, it is submitted, is the most opportune time for laying the foundation of a central land bank in Colombo, with branches in other important centres. The Ceylon Agricultural Society has opened the eyes of the people to the great advantages offered by agriculture in Ceylon on scientific lines, and has given a strong impetus to the cultivation of new products. Even villagers who had hitherto moved in ancient groves are awakening to a new life. An ever increasing number of educated youth of the country are looking out for fresh fields in which their energies might profitably be employed. And not the least important factor to be reckoned in this matter is that in the natural course of events, His Excellency the Governor may give up the reins of Government and retire, and his successor may not have the same enthusiasm for agricultnre. The Agricultural Society may then slacken its efforts, perhaps become purely academic in its proceedings, and finally go the way of many a similar association in the past. Native agriculture may then relapse into its usual condition of torpor. To avoid such a calamity, to enable agriculture in Ceylon to stand on a basis as firm and unshakable as the pyramids, it is to be hoped that His Excellency the Governor who has signalised his administration by founding the Ceylon Agricultural Society, will complete the good work he has begun by inaugurating a system of agricultural banks which the Colony stands in urgent need of.

CO-OPERATIVE CREDIT IN THE UNITED PROVINCES, INDIA.

In the accumulation of practical experience of co-operative village banking, the United Provinces have been peculiarly fortunate. Numerous co-operative banks of this type were founded in 1901, as an immediate result to Mr. Dupernex's labours, and the record of their success or failure has proved of the greatest advantage at the present time, when work has been commenced on broader and more methodical lines.

The village banks were constituted on the Raiffeisen model slightly modified, and were governed by a committee punchayat), which was assisted in the

duty of supervision by Supervisors (girdawars) and with powers strictly limited by rule. The rules provided for the details of working and prescribed *(inter alia)* the terms for and on which loans might be granted, the purposes for which they might be taken, the rate of interest which they should carry, and the rate which the bank should pay on the money borrowed by it.

Of the banks then constituted, about one-third have survived as working bodies, the remainder being either moribund or dead. It is the purpose of this article to examine the causes which have led to the failure of so many of the institutions, and to describe the steps which have been taken to avoid these causes in the societies which have been reconstituted, and in those new ones which have sprung up during the course of the last twelve months.

The majority of the societies had no chance of success from the outset, and it is a testimony to the soundness of co-operative principles that so many successful societies are now at work. The inception of the co-operative movement in these provinces lay not with the people but with Government, and the formation of village banks was a direct consequence of Government orders. Neither the officials nor the landlords by whose action the banks were opened, nor the members of whom they were composed, had any intimate knowledge or any practical experience of the principles of co-operative effort. It is a first essential to the success of co-operation that the members of a society should act voluntarily, and that each member should have confidence in the rectitude and honesty of those with whom he associates and for whose debts he takes upon himself the responsibility. At the outset of the movement there was in most cases no question of voluntary membership. Cultivators became members, not with any intention of contributing to a joint fund and enjoying the benefits which such a fund would confer,—not with any idea of combination in order to obtain credit at more favourable rates than are usually granted to the individual cultivator,—but partly on account of pressure brought to bear by the official or the landlord, and partly in the hope that, in virtue of the payment of a four-anna entrance fee, each member would be entitled to unlimited credit at a favourable rate of interest. The capital provided was not sufficient for the needs of all the members, and the majority of the societies contained a number of high-caste cultivators who obtained favourable consideration at the hands of the punchayat, and being held more reliable than their low-caste fellow-members, were granted loans out of proportion to their number. These loans there was every temptation not to repay, as common justice demanded that on repayment the money should be lent to some other member, who had not in the first instance received any benefit. The punchayat, consisting of members of various castes, and the members themselves in many cases recruited from almost every caste in the village to which the operations of the society extended, were unable to bring effective pressure to bear, loans were not recovered, interest was allowed to run on, and finally the bank died a not unnatural death. Such is the life history of many of the societies which were founded in 1901.

A further cause of failure has lain in the rules and accounts, which were framed for the assistance and guidance of the banks. It has to be borne in mind that in the majority of cases the banks were founded in villages were no professional assistance in account-keeping could be obtained. The person, to whom this duty was confided was as a rule the sub-agent of a zamindar, or the clerk of a Court of Wards' Estate. They did not understand the method laid down for account keeping, and in many cases were most unwilling servants of the Society. Their labours were gratuitous, and from the existence of the Society they personally could draw no profit. It was consequently to their advantage that the Society should cease its operations. Where semi-professional assistance of this description was not available, and a

literate cultivator was appointed to keep the accounts, the result has usually been confusion. With the best of good will, the accountant-agriculturist has not been a success.

In the rules, again, the village societies have found a stumbling-block. The ordinary village member looks upon them in much the same light as the Penal Code, and lives in constant dread of trouble in case of breach of their conditions. The experience gained goes to show that rules should be reduced to the minimum consistent with statutory requirements, and that much, which was originally provided for by rule, should be left either to the by-laws or to the discretion of the punchayat. This view has been accepted by the Government of India.

Besides the difficulties mentioned in connection with the recruitment of members, and the rules and forms of account, there has been in the raising of capital a further serious impediment to the success of the banks. The working capital of the societies was raised in three ways. Commonly it was collected by subscription at rates of interest very much below the market rate, from interested landholders and other native gentlemen. It was in certain instances advanced by Government, also at low rates of interest. In some cases a portion was raised from deposits by the members of the Society. In almost all cases the amount of capital supplied was insufficient for the requirements of the members. It has also been inelastic. There was no method in vogue whereby the capital of a village society could be readily expanded or contracted in accordance with the fluctuating requirements of the members. If more capital than that at present in the hands of a village society is necessary, it can only be obtained at the same rate of interest as that paid on the initial capital by the exercise of official pressure, express or implied, and this, as may be readily understood, forms a serious obstacle to expansion. At the same time the local societies, having enjoyed the advantage of the capital at a very low rate, are not willing to pay the increased rate necessary to attract the money of the ordinary investor. It would entail payment by the members of a higher rate of interest than that which they now pay on loans from the Society, and they feel, unreasonably, no doubt, but still naturally, that it is a breach of faith on the part of the punchayat to charge them two pies in the rupee for accommodation which has hitherto been provided at one pie and a half.

It is, of course, highly desirable that, as far as possible, the village societies should work on capital provided in the village from the members' hoards. That this will in time be the main source of capital cannot be doubted. Experience in certain districts leads to this inevitable conclusion. In most districts, however, there is a distinct aversion to making deposits. The societies are looked upon as a freak of Government, and are not generally regarded as in any sense permanent, or as suitable places in which to deposit money. The investor of the towns has not been attracted. It is not possible that under present conditions he should be. The security of the village societies is not known to him; of their very existence he is probably in ignorance. It is, however, eminently necessary that the village societies should be brought into touch with the world of finance, if they are to be of general utility. Whatever scheme is adopted must contain, as essential features, the existence of a headquarters organisation which is in a position to deal with the large capitalists and the joint-stock banks upon a business-like method, in which it is realized that elemosynary contributions at low rates of interest must, in the nature of the case, be strictly limited in amount, and that practically unlimited capital can be obtained if the business of the societies is sound and they are willing to pay a fair rate of interest for the capital required. The existing organisation societies do not meet the needs of the case. They consist of landlords and others, who have subscribed certain amounts in order to finance the existing societies. They look upon these subscriptions as of a semi-charitable nature,

and in many cases consider that their duty in connection with co-operative societies has ceased, when they have paid the amount expected of them. They are, as a rule, not men of business, and their interest in the societies is purely ephemeral and dependent on the interest taken in those institutions by the District Officer.

Such is a brief account of the initial difficulties under which the village banks in the United Provinces have laboured, and under which they probably labour elsewhere. They are of three descriptions, inasmuch as they relate to the personnel of the society, its rules and accounts, and the raising of its capital. It remains to describe the steps that have been taken to remove them.

In the case of the first of these difficulties the remedial measure is obvions. Of the burdens and hardships entailed by the caste system there can be no doubt, nor is it disputed that the tendency of the system is as a rule hostile to progress and reform. Its existence and its power are, however, a very distinct indication of a method of extension of co-operative effort along the line of least resistance. If members of caste of widely varying social status are enlisted in the ranks of the same society, it is clear that the whole force of the caste system is arrayed against successful effort. It is impossible to believe that a Brahman will become jointly responsible for the debts of a Chamar, or that the influence of a dhobi will suffice to induce a thakur to up a loan, when the latter has preferred the smiling path of recusancy. It is also impossible to expect satisfactory combination between two persons, one of whom enters the village meeting house in order to attend a general meeting of the society's members, while the other is bidden to sit in the street below. Where castes of widely varying social standing are enlisted in the same society, it is obvious that equality, which is the main spring of all co-operative effort, inevitably disappears, and that success cannot result. It is true that there are apparently successful banks in existence where the members are drawn from many and varying castes. Success is in such cases due to the exertions of one or more leading men, who have kept things going in practical independence of the opinions or wishes of the ordinary members.

The classes for whom co-operation holds out the greatest hopes of improvement, both material and educational, are the lower castes. They are at present unable to command the same rates of accommodation as the high-caste agriculturist not because their honesty is less or they are more recusant, but because their individual requirements are smaller in amount. Unless they can be included in the operations of the movement it must so far be held to be a failure. They cannot be included in societies in which high-caste members are enlisted. They must have societies of their own, restricted to members of the lower castes. It seems, therefore, on all grounds desirable that, in the absence of strong reasons to the contrary, the unit of recruitment should be not the village but the caste within the village. This will, of course, not always be possible or advisable, but where it is possible, it will probably also be advisable.

The adoption of a system of caste-societies will result in the multiplication of the number of societies required to serve any given area. It will also render it impossible to demand from the village society the standard of account-keeping which is at present demanded. In the case of low-caste societies, it is improbable that account-keeping of any standard can be required. These are difficulties which have to be faced, and which will be considered later, when the Central system is described.

The problem of accounts in village societies of the existing type has been met by the abolition of standard forms of account, and by empowering the punchayat to keep the accounts in any form which in their opinion best suits the requirements of the institution. This has commonly resulted in the maintenance

of the ordinary forms of account of the country, the zokar bahi, the katz bahi and the zoznamcha. All that is required on the part of the Registration Department is to see that in the accounts kept up in the village, every item of receipt and every item of expenditure shall find a place. The system is not acceptable to the inspecting staff. It is urged that audit is a difficulty, and the simplicity of audit which was a noticeabbe feature of the model accounts prepared by Mr. Dupernex is regretted. The difficulty of audit is one which must be faced, but which must also be overcome. If work is to be continued on existing lines and the movement is to be widespread, and it must be to prove of any practical value, the accounts must be of a nature which the villager can understand. They are kept, not for the auditor, nor for the Collector, nor for the Registrar, but for the people. The society is theirs—they are responsible for its liabilities. It is only just that they should be permitted to keep the accounts in the manner which they prefer, with the one condition that every item of receipt and expenditure shall find a place, and that each man's separate account shall be separately maintained. The remedy for the audit difficulty lies with the auditor. He will have to learn the village system and the vernacular script. Until he has done so he is not fit for his duties.

For the detailed rules by which the original societies were guided and governed, by-laws have been substituted. In the model by-laws which have been prepared for the guidance of the punchayat, the greatest latitude has intentionally been left to those bodies. The problem to be faced is not one of principle but one of method; and the method suited to co-operation in the Provinces can only be discovered by experiment. Consequently, every point, which could well be left to the punchayat for determination, has been left to that body. The terms on which a loan is granted, as to interest and repayment, the objects on which such a loan may be expended, the power to grant extensions, whether on payment of interest or not, all these are matters which are left to the judgment of the local committee.

This at once raises the thorny question of unreproductive expenditure. In considering this question it is necessary to bear in mind that the circumstances of this country are very different from those of the countries where co-operative credit had its birth. The problem is unique. The agriculturists of these Provinces has from time immemorial pursued the same rocky financial path. He takes advances from the village money lender for seed, for cattle, for food between harvests, for the clothing of himself and his family, for the marriage of his son or his daughter, and for the disposal of his dead. His bania or village money lender has as much right in him according to all the cannons of village custom, as he himself has in his occupancy holding. Any departure from this custom of centuries at once creates a suspicion of faithlessness on the part of the borrower, not only in the breast of the money lender whom he deserts, but in the opinion of his co-villagers. Under normal circumstances and in the absence of pressure, it is incredible that one of the clientele of the village money lender will go elsewhere than to that money lender for any of his financial requirements; and it must be said that as long as he remains faithful to the money lender, the money lender also remains faithful to him. The bania does not refuse accommodation to his hereditary clients, except under stress of the most abnormal circumstances. Though rejoicing in the name of the village Shylock, the local money lender is in fact indispensable, and on the whole reasonable. The bond which he takes for advances made is more in the nature of an insurance than an instrument to be used to prove a case in Court. It very seldom actually represents the amount of the loan, and as long as the borrower makes no attempt to remove his custom elsewhere, no suit on the basis of the bond need be anticipated. If any of his debtors are, for reasons other than

recusancy, unable to pay, they are not pressed, and of the profits of the business, probably the greater portion exist only on paper. In obedience to village custom, the money lender is bound to advance money in many cases in which he knows that a bad debt is a moral certainty.

If co-operation is to be of any benefit, the society must for its members replace the bania not only with advances for seed grain, bullocks and manure, but also in their thousand and one other financial requirements. No one will willingly join a society where the benefits are confined to these minor matters, for by so doing he at once cuts his hereditary connection with his money lender, and cannot, consequently, raise elsewhere than from the society absolutely necessary accommodation for other expenditure. Until co-operative societies are prepared to replace the bania, not only with loans for reproductive, but also for legitimate and necessary, but unreproductive, expenditure, they will fail of their ultimate object, which is to extricate the agriculturist from the burden of ancestral and perpetual indebtedness.

It is very generally assumed that this course will result in risky business, and that the cheapness of loans will induce even greater extravagance than at present on festivities connected with marriages, funeral and other domestic and social events. The opposite may be expected to be the case where the loans are granted by co-operative societies to their members. In these societies each and every member of the institution, including the members of the punchayat, is responsible for all loans granted to members. The punchayat will, therefore, exercise peculiar care in making loans for unreproductive purposes. It may be that a cultivator will come to the punchayat and ask for a loan of Rs. 200 wherewith to marry his daughter. The punchayat knows his social position and his circumstances, and decides that Rs. 50 is an appropriate sum to advance for the purpose, and grants that sum. The cultivator accepts it, goes to his fellow caste-men, and though in his heart rejoicing at the curtailment of his expenditure, he explains that he was prepared to spend the larger sum, but that the punchayat refused to allow him the accommodation. He thus saves his pocket and his izzat at the same time. Had the society been debarred from advancing loans for purposes of marriage expenditure, the cultivator would probably have obtained the money from the local money lender at the expense of his connection with co-operative credit and at an exorbitant rate of interest. He would probably also have carried the burden of debt for the rest of his life, and handed it as a legacy to his successor. On the principle, therefore, that as much as possible should be left to the local committee of management, the objects for which loans may be granted have been left to its determination. The result will be carefully watched, though there is at present no sign that the latitude left to that body will be abused.—(*By J. H. Simpson, Registrar of Co-Operative Credit Societies, U. P. India.*)

(*To be continued.*)

The Kurunegaa Agri-Horticultural Show, 1906.

Report on Classes A, B, C, and D.

Class A, Flowering Plants in Pots.—It was very disappointing to find that out of twenty prizes offered only three were competed for, and only one entry for each of these. The drought can hardly account for this.

Class B, Cut Flowers.—The space allotted to this class was insufficient, and the exhibits were somewhat cramped. Most of the flowers were good, but there was practically no competition, and only six prizes out of the fifteen were awarded. A good bloom of Maréchal Niel Rose was awarded a special prize. Show boxes should be used.

Class C, Foliage Plants in Pots.—The exhibits in this class were very pleasing, and much credit is due to the exhibitors, for evidently care was taken to stage clean, well-grown plants. Taking the class as a whole I was agreeably surprised, and have not seen a better grown lot at any low-country show.

Class D, Ferns in Pots.—This class was very good indeed, and special mention should be made of Mr. Goonewardene's *Adiantum farleyense,* which was deservedly awarded two prizes, viz., for the best *A. farleyense* and the best fern of any kind.

J. K. NOCK,

Acting Curator, Royal Botanic Gardens.

Report on Sections E. and F.

E.—Fruits.

1 to 7. Plantains: not satisfactorily represented, and only one bunch was fit for eating.

8 to 10. Not many exhibits, but the prize oranges were specially fine.

11. Coconuts: an excellent exhibit and good competition.

12, 13, 14. Pines: nothing good.
15. Durians: none.
16. Melons: a good show.
17. Grapes: none.
18. Limes: only fair.
19. Guavas: poor.
20. Sonrsops: none.
21. Custard apples: fair.
22. Bullock's heart: none.
23. Rambutans: nothing worth mentioning.
24. Lovi-lovi: nothing worth mentioning.
25. Papaws: only fair; fruit not mature.
26. Nam-nams: good.
27. Jak fruits: none.
28. Breadfruit: none.
29. Best collections of fruits: one good exhibit.
30. Bilings: fair.
31. Kamerungas: good.
32. Jambus: none.
33. Nelly: only one exhibit.

F.—Vegetables.

1. Ash-pumpkins: very fine specimens and good competition.
2. Bottle gourds: poor.
3. Pumpkins: very largely and well represented.
4. Snake gourds: excellent.

5. and 6. Sugar-cane: only fair.

8. Turnips: only one exhibit.
9. Carrots: only one exhibit.
10. Vetakolu (luffa): very good specimens.
11. Beet root: two good exhibits.
12. Brinjals: good.
13. Bandakais: good specimens but too few.
14. Ash-plantains: only one exhibit.

15, 16, 17. Beans: very poor.

18. Princess bean: none.
19. Tomatoes: fair.
20. Lettuce: only one exhibit.
21. Sweet Potatoes: good.
22. Chilies: should have been better represented.
23. Capsicum: one excellent exhibit.
24. Cucumbers: very good.
25. Onions: good.
26. Cabbages: only one exhibit.
27. Jerusalem artichoke: none, except among the school garden collections.
28. Murungas: good.
29. Spinach: fair.
30. School garden collections: two good exhibits from Nakkawatta and Nikaweratiya.

Yams: disappointing, except in the case of manioc.

Two special prizes were recommended for—

(1) A collection of fruits.

(2) A collection of wild edible products.

August 23, 1906. C. DRIEBERG.

Report on Section G.

The native drugs were but a poor show—very little variety.

The prize sample of coconut oil was particularly good; the others rather poor.

The tobacco was not very good, the leaves mostly being very full of holes, and it was also very damp, but this was due to the rainy weather.

The coconut poonac was good, the gingili poonac poor.

The oils were mostly of fair quality, but the show was but scantily provided with them.

The tree (Caravonica) cotton shown was clean and well ginned, but the staple varied much in length, as perhaps is usually the case with hybrid cottons, some of it was 1½ inch, some only ¾ inch. The sample of Sea Island beside it was really better as regards staple, but it was dirty and discoloured.

The rubber was good, and the choice between the two lots was somewhat difficult. Neither lot was properly resilient.

JOHN C. WILLIS

Kurunegala, August 23, 1906. *Director.*

REPORT ON SECTIONS J, L, M, AND R.

J. *Dairy Produce.*—All classes poor in numbers and little competition, except for cow and buffalo ghee. The exhibit of butter by Mr. C. A. Andree deserved special mention. It was very neatly shown.

L. *Cattle.*—A very good show of cattle. The travelling carts with pairs of bulls were a very good exhibit. The show of bulls was the principal part of the class. Cows were few and of no especial merit. No sheep, and only two goats were shown.

M. *Poultry.*—The show of poultry was on the whole disappointing. They were small in size, and not cleanly shown. They should be washed before exhibiting.

R. *Horses.*—Five ponies under 12 hands were shown. The first was a smart roan pony, and the second a nice bay 2-year old, which will develop into a good pony with care.

In turnouts, only two single turnouts were shown, the first going to Mr. E. E. Gunawardena with a nice Australian horse and rubber-tyred victoria. The second was a nice moving grey cob, the property of Mudaliyar S. M. Fernando.

An extra class for larger horses was provided, Mr. F. G. Tyrrell taking first place with a nice quality Australian mare, and Mr. W. C. Price second place with a strong bay cob, who would perhaps have fared better had he been ridden or driven and better shown.

G. W. STURGESS.

August 23, 1906.

The Kelani-Valley Agri-Horticultural Show, 1906.

REPORT ON FRUITS AND VEGETABLES.

Fruits.—The show of plantains was very disappointing, the only noticeable exhibit being one of "Ash" plantains from Salawa Estate (Mr. J. W. C. de Soysa's property).

Oranges were much better, and there was very good competition here—the best sample coming from Paradise Estate. Limes were also good, the prize going to R. A. Dassanaika of Dehigahapitiya.

Soursops and rambutans were fair, and the awards for both went to Salawa Estate.

A very fine basket of lovi-lovi fruits gained the prize for Cader Tamby of Dehiowita.

The papaws shown were well grown, of good size and quality. The best were those shown by Agris Jayawardene of Padukka.

Sapodillas were poor, the only fairly good specimens coming from Salawa Estate.

The good basket of nelly fruits was sent in by M. D. Julis.

Paradise Estate also gained the prize for breadfruits, the exhibits of which, however, were not particularly striking. Other fruits mentioned in the catalogue were either entirely absent or unworthy of notice.

Vegetables.—Exotic vegetables were very poorly represented, and this fact goes to prove that few persons, if any, grew specially for the show. Beans, lettuces, and beets were fair, but there is no reason why these and other exotics should not have made a striking class in themselves, if a proper attempt had been made to grow them.

Of yams and sweet potatoes there were excellent specimens, the collection sent in by the Mudaliyar of Hewagam Korale being the best.

Maniyagama school took the prize for snake gourds, and Salawa Estate was again to the front with a fine show of bandakais and bitter gourd.

Chillies, cucumbers, ash pumpkins, brinjals, luffa (vetakolu), spinach and lasia (kohilla) were all good.

The best general collection of vegetables was that sent in by Juanis Appu.

C. DRIEBERG,
Superintendent of Schoo Gardens.

Colombo, 14th September, 1906.

Report on Class III., A. and B.

I have the honour to report as follows on sections A. & B. of Class III, (viz., Vegetables and Commercial Products and new Products respectively), at the Agri-Horticultural Show held at Talduwa, on the 7th and 8th instant.

This being the first show held in this district, these sections were perhaps more creditable than the mere list of entries suggests. The keenest competition was in coconut oil and rubber, of which there were 40 and 12 entries respectively. None of these were really of mean merit, and the work of the judges was to select the best of what was all good. The following is a detailed account:—

Vegetable and Commercial Products.

Exhibits.	No. of Exhibits.	Remarks.
Coconut oil ...	40	All good
Cinnamon oil	—	—
Medicinal oils	1	A large collection
Tobacco ...	2	No prize awarded, both being disqualified
Native fibres	1	Rather poor
Gingelly oil ...	1	Fair
Kekuna oil ...	1	do
Gums and resins	1	do
Native dyes...	—	—
Gamboge ...	—	—
Coconuts ...	3	Good specimens
King coconuts	6	All good
Arecanuts ...	2m	Good

New Products.

Exhibits.	No. of Exhibits.	Remarks.
Groundnuts ...	5	Pretty fair samples
Groundnut oil	—	—
Groundnut poonac	1	Very inferior, disqualified
Cleaned cotton	4	All good
Rubber ...	12	do

(Sgd.) H. F. MACMILLAN,
Curator, Peradeniya Gardens

13th September, 1906.

CATTLE AND POULTRY CLASSES.

Cattle Section.—Very few cattle were shown. The coast bulls made the best class. The exhibits of native cattle were poor. Altogether a rather disappointing section.

Poultry Section.—Was a fairly good section. The birds were conveyed to the show in larger cases, and proper pens were provided at the show.

(Sgd.) G. W. STURGESS,
Government Veterinary Surgeon.

Colombo, 10th September, 1906.

The Kegalle Agri-Horticultural Show.

SECTIONS I, II, III, AND IV.

I have the honour to report as follows on Sections I, II, III, and IV at the Agri-Horticultural Show held at Kegalle on the 21st and 22nd instant.

Generally speaking the show, as regards purely native products seemed to be a very satisfactory one, and in my opinion approached what such village shows should be. Order and method pervaded the general arrangements to an extent not usually seen.

Section I. (Plants in Pots).—All classes under this head were competed for, except Roses and Geraniums. Ferns in pots and Chrysanthemums in flower were quite good.

Section II. (Cut Flowers).—There was a large display of these chiefly native flowers. A rather novel (but not quite clear in meaning) class termed "Malwattiya" drew a large number of competitors.

Section III. (Vegetables).—There was a good general collection representing every class in this section. Yams of good quality (and others as monstrosities) were much in evidence, the prize going to an excellent collection of 29 edible kinds shown by Ratemahatmaya Boyagoda. A nice exhibit of vegetables was that shown by Hettimulla School Garden.

Section IV. (Fruits).—There was strong competition in plantains, oranges, papaws, and limes, but pineapples were poor, these being now out of season. Had the prizes offered in this section been less limited, a greater variety of fruit would doubtless have been brought together.

H. F. MACMILLAN,
Curator, Peradeniya Gardens.

28th September, 1906.

DAIRY PRODUCE AND CATTLE.

SIR,—With reference to your letter No. 3974 of the 25-26 September, 1906, I have the honour to inform you that in the Dairy Produce Section the Exhibition of ghee and eggs was good, the remainder of the sub-classes very poor. What poultry were shown were very fair, but poor in numbers and not properly cleaned and prepared for exhibition. The Cattle Section was a good one, especially for native bulls. There might have been much more competition if owners would enter their cattle.

I am, etc.,
G. W. STURGESS,
Government Veterinary Surgeon.

Colombo, 28th Sept., 1906.

Lessons in Elementary Botany. V.

By J. C. Willis.

We must now pass on to consider the reproductive organs, remembering that the chief feature in the life history of a plant is its reproduction. It is customary to distinguish between *vegetative* and *true* methods of reproduction. The former is the detachment of portions of the vegetative system—specialised for the purpose as in the case of the tubers of a potato, or not, as in the case of rubber cuttings—which may grow into new plants without any further reproductive phenomena. True reproduction, on the other hand, is propagation by special cells (the unit parts of plants) set apart for the purpose. These may be able to grow into new organisms without any sexual process, or they may require, as a preliminary to further growth, to fuse together in pairs, male and female. In the first case we speak of asexual reproductive cells or *spores*; in the second of sexual, or *gametes*, which by their union produce a new cell or zygote capable of further development into a new individual.

The spores are contained in little capsules or *sporangia* seen in their typical form on the back of a ripe fern-leaf, where they are usually aggregated into groups called *sori*. As a rule in ferns the sori may occur on the backs of any or all of the leaves; but in many cases they are on special, usually smaller, leaves—usually with narrow segments. In the clubmosses, near relatives of the ferns, the *sporophylls*, as the spore-bearing leaves are generally termed, are aggregated into *cones* at the end of the branches, and a somewhat similar phenomenon is seen in all the flowering plants, the flower corresponding (to a large extent) to a cone, the stamens and carpels being the sporophylls.

In the ferns there is only one kind of spore, all being of the same size, but in the selaginellas (common in upcountry jungles, creeping on the ground) there are large and small spores; and the same is the case in other plants.

When the spores of ferns are sown upon damp soil (try this on wet sand) they germinate and give rise to delicate little green leaf-like plants, called *prothalli*, entirely different in structure from the ordinary fern plant. The prothallus is sexual and bears the male and female cells or gametes, which when united give a zygote capable of growing, not into a prothallus again but into a leafy fern plant like the one with which we started. The female cells remain in their receptacles on the prothallus, and the new plant is therefore attached to the prothallus for some time (allow the fern spores to grow for a considerable time and presently the young fern plants will appear on the prothalli.) We may therefore sum up the life history thus:—

```
Fern  plant ——> sporophylls ——> sporangia ——> spores
  ^                                             |
  |                                             |
  |                                             v
          <——male   gamete <——male   receptacles \
Zygote <——female    do.    <——female    do.      } prothallus.
```

In Selaginella, &c., the big spore gives a female, the small a male prothallus.

In the flowering plants this same alternation goes on, but the prothallus stage is much reduced. The big spore germinates without falling off, and the small spore, or pollen grain, is carried to its neighbourhood by the wind or by insects, and germinates there. The growth of the zygote stops for a while, after a time, and we say that the *seed* is *ripe*.

Before we consider the flower in detail, we must briefly describe the ways in which flowers are arranged upon the plant—the *inflorescence*, as it is termed. Very commonly a plant has only one inflorescence or tuft of flowers, but most often has several.

The flowers may be sessile (stalkless) or on stalks. Each flower usually arises in the axil of a leaf, termed its *bract*, and any leaves between the bract and the flower, on the same stalk as the flower, are termed *bracteoles* or bractlets. Most commonly there are either two or one, but they may be absent, or many. Sometimes the stalks of the flowers of the inflorescence all start at one point and then the bracts are generally condensed there into a whorl or *involucre*. The term is also given to a whorl of leaves on the same stalk as one flower. Sometimes the bract is a large leaf more or less enclosing the whole inflorescence, and is then termed a *spathe*.

Flowers may be solitary, or two or three together in the axils of all or some of the leaves, but most commonly they are massed into inflorescences. The simplest type is the *raceme* in which the main stalk grows steadily onwards, bearing lateral branches in regular succession, and each lateral branch ending in a flower (see plate). This is well seen in cress, mustard, etc.

If, instead of each branch of a raceme being one-flowered, it forms a raceme itself, the resulting inflorescence is a *panicle*. But the definitions of inflorescences are loosely applied, and any inflorescence presenting this loosely branched appearance is usually called a panicle. If in the simple raceme we imagine all the flowers sessile, we get a spike, as in the agrimony, etc. If in a raceme the lateral stalks grow so rapidly as to keep all the flowers at one level, we get a *corymb*, as in candytuft. If we imagine all the flowers of the corymb to spring at one point, we get an *umbel*, and if the flowers of an umbel be imagined sessile, a *head* as in dandelion, goatweed, sunflower, etc., (see plate for all these). In all these inflorescences the order of opening of the flowers is evidently towards the centre, where the youngest flowers will be, but in many inflorescences the oldest flower is in the middle and the younger ones outside. Such inflorescences are called *cymes* and may be of many forms, often more or less closely imitating the racemose inflorscences (see plate).

The great advantage of an inflorescence appears to be the massing of the flowers close together, so that insects are more attracted by the greater conspicuousness, and the chance of pollination is much greater.

THE FLOWER.

The flower consists essentially of a short shoot or stem, the *receptacle*, bearing sporophylls, the *stamens* and *carpels*. The former are usually short stalks, each ending in an *anther* or receptacle for the little *pollen grains*, the latter are generally united in various ways as we shall see. In addition to these, nearly all flowers have also a *perianth* or set of non-spore-bearing leaves, outside the stamens and carpels. As a general rule these are in two rows, an outer green or membranous, called the *calyx*, and composed of *sepals*, and an inner, brightly coloured, the *corolla*, composed of petals. In such a flower as the lily, where all the leaves are alike, we speak of the perianth, and perianth-leaves.

When we examine a lot of different flowers, we find what at first sight appears to be almost infinite variety in them. Some have three, some four, some five leaves, or stamens, or carpels, in a whorl, some have no definite whorls at all; some have the petals free from one another, some united; some have no stamens or no carpels; some have the stamens united to the petals, some not; some have convex, some concave receptacles, and so on.

When we examine the flowers in detail, we find that all this immense variety can be brought under a few heads, with which we may now proceed to deal.

Segregation of the Sporophylls (stamens and carpels), or grouping of each kind by itself, is characteristic of existing flowers. They may be all in the same

hermaphrodite or *bisexual* flower (these sex terms, as will be evident from what has been said above, ought not, strictly, to be applied here, but they are firmly established in botanical literature), or they may be in separate *unisexual* flowers, the stamens in *male*, the carpels in *female*, flowers. In bisexual flowers the carpels are in the centre, the stamens around them.

As the construction of the flower is the most important feature upon which the classification of plants rests, it will be necessary to give here a few at least of the most important technical terms in use, and we shall give them after each section.

Flowers may be *bisexual*, or *unisexual* (male and female). Plants with male and female flowers on the same plant, *monoecious*, on different plants *dioecious*.

Reduction in number of the Sporophylls, and their arrangement in Whorls are two very widely spread features of existing flowers. Many of the lower types of flower, for instance the buttercup, have their leaves not in definite whorls, and have a large number of stamens and carpels, but in most flowers this is not the case, and as we go up in the series of plants, the number of stamens and carpels, more especially the latter, tends to decrease.

Flowers with 2, 3, 4, 5, members in each whorl, *di- tri- tetra- penta- merous.* If the number is over ten, and, variable, it is *indefinite.* Members of one whorl are usually *alternate* to those of the next, *i.e*, occupying the gaps between them, but may be *opposite* to them.

Cohesion, or union of similar organs, is very common. It is most usual in the carpels, very common in sepals, less so in petals, rare in the stamens.

Perianth, calyx, corolla, stamens, carpels, of organs quite free from one another, *polyphyllous, polysepalous, polypetalous, polyandrous, apocarpous;* of coherent or united organs *gamophyllous, gamosepalous, gamo-* or *sym- petalous, monadelphous* (if all the stamens united; see below under stamens) *syncarpous.* The united portion is termed the *tube*, the free parts the *limb*, divided into *lobes, teeth*, or *segments.*

Adhesion, or union of dissimilar organs, is also very common. The most usual case is for the stamens to be united to the petals.

Stamens united to the perianth, calyx, corolla, *epiphyllous, episepalous epipetalous;* carpels and stamens united, *gynandrous.*

(To be continued.)

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By J. C. Willis.

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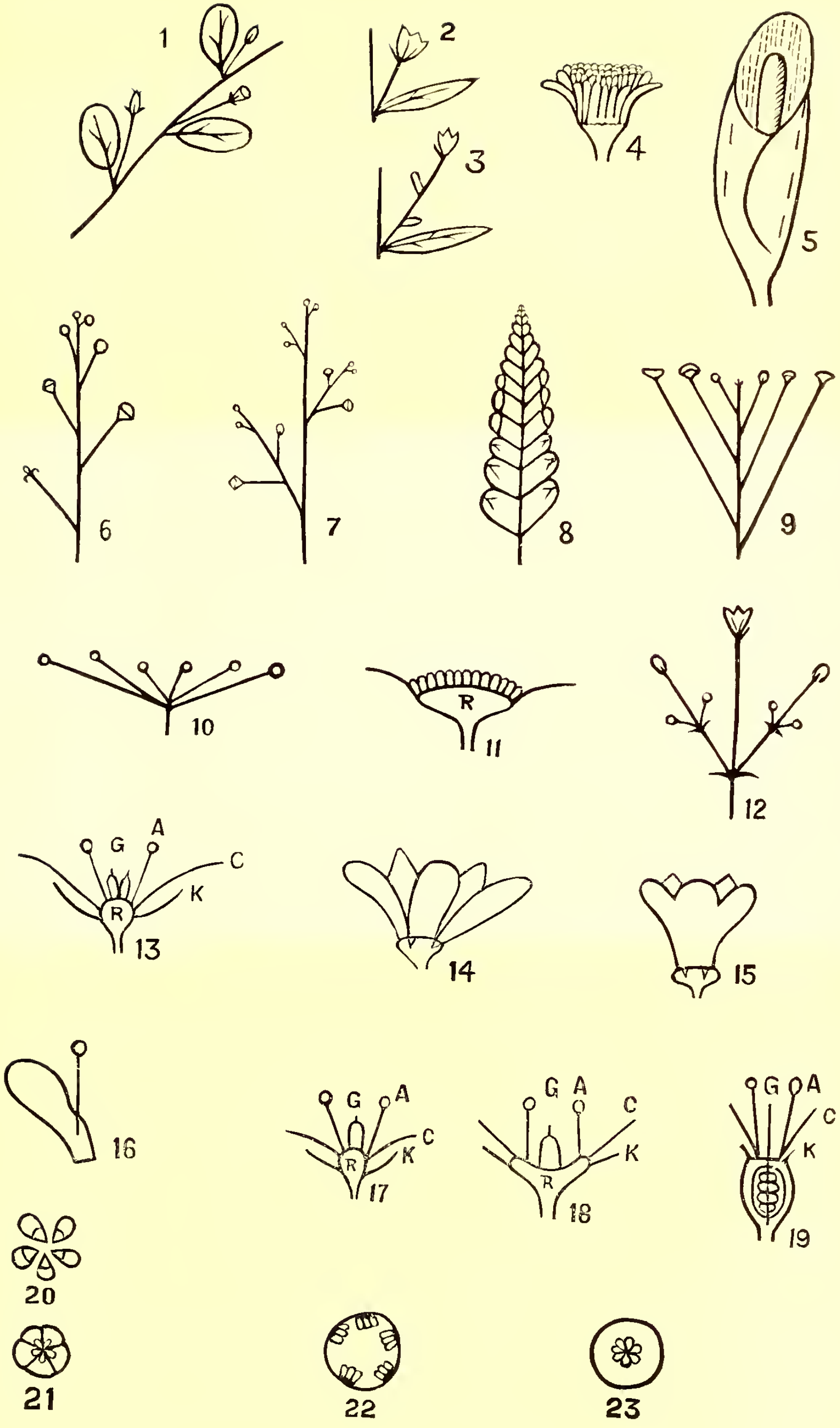
Explanations of Plate III.

1 Solitary in axils
2 Bract
3 Bracteoles
4 Involucre
5 Spathe
6 Raceme
7 Panicle
8 Spike
9 Corymb
10 Umbel
11 Head
12 Cyme
13 Imaginary flower in section
14 Polypetalous corolla
15 Sympetalous corolla
16 Epipetalous stamen
17 Hypogynous flower
18 Perigynous flower
19 Epigynous flower
20 Apocarpous ovary in cross section
21 Syncarpous multilocular axile placentas
22 Syncarpous unilocular parietal placentas
23 Syncarpous unilocular free-central placenta



LESSONS IN ELEMENTARY BOTANY. PLATE III.

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SCIENTIFIC AGRICULTURE.

THE CONSERVATION OF CATTLE MANURE.

The attention given to the conservation of farmyard manure in France is one of the striking things noted in his travels by an agricultural correspondent. "In the yard near the stock buildings on one of the farms visited" he writes, "is a brick enclosure in constructed cement on the inner side. Beneath this, and in the centre, is a large tank into which the urine from the different buildings is conveyed by drainage. The tank is covered by an iron grille, above which the manure is stacked, the heap having vertical sides, and being built from day to day with every care. Above is a roof to keep off the rain, while in the very centre of the heap, and rising from the tank, is a pump. In the natural order of things the manure is wheeled from stable, piggery and cattle shed on to the heap, and carefully spread, so that each form of manure is well mixed, and the quality of the heap equalised as far as possible. From time to time the urine within the tank is pumped over the heap, which is kept well soaked and cool, and in this way, although some loss may occur by volatilisation, the heap is kept from fermenting too rapidly, while the liquid is largely absorbed." Commenting upon the almost universal attention given to the saving of farmyard manure in France, this correspondent thus refers to its exceptional value :—

"The value of this manure does not consist alone in the proportion of fertilising matter which it contains. Farmyard, unlike artificial manures, possesses two values, the one fertilising, the other mechanical. The mechanical condition of a loamy soil is known to be such that crops can be grown upon it with greater ease and success, while it absorbs less labour than a heavy soil. Many clays have great crop growing capacity, but only in proportion to the labour and the farmyard manure bestowed upon them. The fine mechanical condition of a loam is chiefly owing to the high percentage of organic matter which it contains. Add the same quantity of organic matter to a clay and its crop-growing value is at once improved, and improved to a considerable extent. It is for this reason that this manure, which is chiefly composed of organic matter, is of such great importance to heavy lands. Clay soils are almost useless until they have been pulverised, but even then their value is little until they have been well and repeatedly dressed with farmyard manure, which prevents excessive tenacity, permits the entrance of air and water, adds warmth, and generally conduces to the crop-bearing capacity of the soil. As the straw and other organic matter in the manure slowly decomposes, the fertility it contains is liberated; while during the decomposition heat is evolved, and heat is of great importance to plant life. What has been said applies equally to the lighter soils, for just as farmyard manure reduces the tenacity and heavy condition of clays, so it conduces to the homogeneity of the lighter soils, which are too loose, too pervious to water, and too lightly furnished with decomposing material."—*I. P. Gazette.*

Correspondence.

RUBBER TAPPING METHODS.

Dear Sir,—The *Tropical Agriculturist* for September has done me the honour of publishing my letter and diagram of 18th August on the above subject, and its learned Editor has condescended to "sit on" me. He says in a footnote:—"The full spiral leaves L. F. C. untapped." With all due respect to constituted authority, I say it does not, as he will see if he folds the diagram into a cylinder till A. C. and B. D. coincide, or if he will look at a tree that has been completely spirally tapped. But, *ne sutor ultra crepidam*, my apology is due for the unscientific statement, which I must have cribbed out of our Rubber Handbook, that "the latex cells have the power of sealing themselves up." Like the genial Government Agent, C.P., *I now know that* "the latex accumulates in *other* cells near by"—so near, that it takes a high-power microscope to see it. And as a mere practical tapper, who does not go about his work armed with even a magnifier, perhaps I may be forgiven this slip. What my eye sees is the whole of the last tapping line sealed up and dry, as it were, and a thin paring cut starts the flow of latex again all along the line.

Now, to continue the subject matter of my previous letter. During the whole time of the Rubber Exhibition I was present in a subordinate capacity and met a great many rubber planter friends, who nearly all told me "the spiral is doomed"; but not one of them could give me a valid reason for saying so. Some reasons given for holding these views were:—(1) The general opinion among rubber men, (2) It is too drastic, (3) The Controller's figures prove it is more wasteful of bark than the herring bone system, and (4) The exploded one of ringing the tree.

Well, (1) general opinion is sometimes proved to be wrong. In this case it seems to have been formed by a bell-wether of the rubber flock having plunged through the hedge and the young rams are following gaily through the hole, asking no questions! (2) Any system of tapping may be *made* too drastic; and that is precisely what has been done in the case of the spiral. The arbitrary rule of 1 foot-spacing has been followed to the letter, and spirals and herring-bones have been clapped on to the trees alike, forgetful of the fact that the former means *double* the length of tapping lines of the latter on the trees and therefore, presumably, double the strain on the latter.

Look at the medals commemorative of awards of the Rubber Exhibition. The obverse is a reproduction of a *Hevea* monarch. The unfortunate monarch is now carrying 8 lines of spiral tapping aggregating some 56 lineal feet,—not that he could not carry three times the amount if reasonably spread over his magnificent limbs, but this is all clapped on within six feet of the ground. Please note that if he had been "herring-boned" he would have been carrying only half of this, viz., 28 feet. Ninety per cent of his lesser brethren under tapping are similarly *spirally over-tapped*. And (3) it is from the yields of these trees that the Controller of the Experiment Gardens has drawn his data to compare with those of the herring-bone system, manifestly an unfair comparison, apart from the question of the varying angles of cut which I discussed before, and nobody has, so far, controverted. To make a fair comparison, either the alternate lines of the spiral should not have been cut, or the herring-bone should have been cut on both sides of the tree.

This, of course, is preposterous and mere heresy to the advocates of the herring-bone system; the other side of the tree is left intact so that there may be no question of the uninterrupted flow of sap. Exactly so: and when the first side

has run out, what then? Proceed to cut the herring-bone on the second, while the first is resting. Just so; and make four (out of the five) complete ringings of the tree (4) which you were so keen to avoid; or leave a space and waste it; or trust to the lacerated bark in 5 parallel sets of lines of the old cut to take up the flow of sap; or wait a bit till it can, and lose yield? What ho! Is there any thing connected with spirals so drastic or wasteful as this? I trow not—yet I make no doubt that much swamp-gas will be belched forth to meet this new aspect of the case.

A captious critic might say that I have "an axe to grind" in my advocacy of the spiral, in so far as I was a co-exhibitor at the Rubber Exhibition of several applications of the spiral system, which have been noticed in the press.

While I have criticized the bases on which the Controller has drawn his deductions as to bark excision and yield, it would be unfair to pass lightly over the fact that he was the first to point out the loss of profit as well as the shock to the tree, in too rapid excision of the bark, and the first to advocate shallow channelling and deep pricking to release the latex; and by these methods to ensure the more rapid renewal of the bark. It is a moot point, however, whether pricking is not a very dangerous operation unless carefully done—at least more dangerous than paring deeply though thinly. The farrier's knife and adaptations of it seem to be having a good look in again, chiefly, seemingly, because of the large task in trees a cooly can do with it. I imagine this will entail a future compulsory rest for the tree—and for tapping operations too!

Apologising for the length of this letter, I am, Sir, yours faithfully,

ALEX. CAMERON

September 29th.

[Portions of the letter which do not bear upon the subject have been omitted.—Ed.]

"SPENCE COTTON" IN INDIA.

Sir,—Since the publication in the press of my letter on the subject of "Spence Cotton," I have received innumerable congratulations from all parts of India for having been fortunate enough to discover a cotton indigenous to the country and infinitely superior both in staple and appearance to that grown in the United States of America. The immense importance of this and the wide field it opens in the future for the extension of India's manufactures, I am glad to find, is recognised on all sides. I therefore feel confident it will interest your readers to learn the results of a trial of "Spence Cotton" in the mills of Bombay. This Messrs. C. N. Wadia & Co., of the Centuary Mills Co., Ld., have been good enough to carry out for me, and the following is their report:—

Bombay, 11th September, 1906.

J. R. Spence, Esq.

"Dear Sir,—We have passed the four bags of 'Spence Cotton' through the processes of spinning and weaving, and have now the pleasure to forward you herewith sample of cloth made therefrom, which we believe is the finest that has ever been made in the power looms from Indian-grown cotton. The cloth is made from 40s warp and 50s weft, and from this trial we are satisfied that the cotton will spin a good 50s warp and 70s weft, from this cloth can be made in fine dhoties for which a great demand exists in India, particularly on the Bengal side, thanks to the Swadeshi movement. To be able to grow such cotton is one of the best things that the Indian

mills could wish for, and will open up quite a new and very profitable trade, if they will get machinery suitable for the longer staple. If we had had a larger quantity of cotton with which we could have continued the trial, making necessary changes, we are sure a still finer cloth could be made from it. The total loss of weight in blow room is only 3% and we would gladly give 7 annas per lb. for this cotton."

The excellence of the cloth proves the correctness of the opinion I held eighteen months ago that this undoubtedly is the raw material from which the "Dacca Muslin" was made many years ago, which acquired a world-wide reputation for the excellence of its quality. Experts in Bombay and Mysore were of the same opinion at the time. Messrs. Forbes, Forbes, Campbell & Co. have kindly consented to show samples of it at their offices in Hornby Road, to those desirous of inspecting it. In spite of the abnormally bad season on this plantation,—for last July we had 26 inches of rain in two days and not a drop afterwards for seven months, when on the 16th February, the heavy unseasonable rain did incalculable harm,—I am glad to be able to state that my first estimate of the yield per tree has been found to be correct. Average trees a year old were marked and all the cotton carefully put into separate bags, the result being an average of 2½ oz. per tree. But I am most anxious to be absolutely on the safe side, and have therefore reduced my present minimum estimate to 1¼ oz. per tree, and as 5,000 are now planted to the acre, this gives a result of 400 lbs. of clean cotton or one bale per acre. The second year this is doubled, and increases enormously afterwards during the tree's known life of twenty years. I am exceedingly glad to read the favourable reports of the extensive trial of Egyptian seed in Sind. I have had five years' experience of Egypt, and four years ago strongly recommended it to the commercial community of Bombay, selecting the South of Hyderabad as the most desirable spot to cultivate it. I am naturally much gratified to find that my anticipations of its success have been amply verified. The chief difficulty, of course, is to induce cultivators to adopt the Egyptian methods in place of their present crude ones, and this must be done every season; whereas in the case of "Spence Cotton" the difficulty has to be overcome but once in twenty years, and it will grow and flourish in any soil instead of being confined to Sind only. The immense advantage of this tree over the annual shrub is evident to the meanest capacity. Take the yield first: the late Mr. J. N. Tata estimates the average all over India at 30 lb. of clean cotton per acre. I have visited every cotton-growing district of any importance in the country, and consider this is much too low. I am of opinion the average on non-irrigated land is from 45 to 50 lb. per acre—a deplorably poor outturn, in Egypt the average is 400 to 500 lb., and in the United States 200 to 250 lb. I have a method which would more than double the present yield and at very little extra outlay or necessity for intelligence; but why cultivate such rubbish at all?

I am, Sir,

Yours, faithfully,

J. R. SPENCE.

ANT HILL EARTH.

Dear Sir,—I shall be obliged if you or any of your readers can enlighten me on the advantages derived by the use of earth from ant-hills in refilling holes dug in indifferent soils, where a good surface soil is not obtainable, for the purpose of planting different products, such as, tea, rubber, cocoa &c.

Kandy. K. B. B.

[The earth is very finely divided, but we do not know of any other advantages it may possess.—Ed.]

Current Literature.

Year-Book of the United States Department of Agriculture, 1905.—Published at the Government Printing Office, Washington; 815 pages, with 31 articles and an appendix of 44 articles, 73 coloured and photographic plates and 130 text figures; Edited by Geo. W. Hill. This is one of the best annual agricultural publications we know of, and deals with every phase of agriculture practised in the United States, with details of the year's progress and work in each department or branch of the many agricultural industries. The report of the Secretary to the Department, Mr. James Wilson, occupying 122 pages, reviews the year's work and states that 1905 was another year of unsurpassed prosperity to the farmers of the country. After supplying the wants of the people there was an enormous surplus of agricultural produce for export; and to mention only two articles, the increase in the exports of cotton was valued at £1,870,000, and that of rice at £400,000. The increased prosperity of the farmers has led to a large multiplication of small farmers' banks throughout the agricultural regions, banks for which the farmer has supplied the capital as a sound investment. "The man with the hoe has become the man with the harvester and the depositor and shareholder of the bank." The Weather Bureau has proved a useful department to the agriculturist; and the extension of its work in the arid and sub-arid regions has been of great value in the extensive rrigation works in these parts. The Bureau of Plant Industry reports much useful work accomplished in plant sanitation and the treating of plant diseases, in achievements in cotton breeding, in work on nitrogen fixation, investigations into drugs and poisonous plants, etc. The Forest Service, the Bureau of Chemistry, the Bureau of Soils, the Office of Experiment Stations, all show continued active progress. The Bureau of Entomology shows important results gained by the introduction of beneficial insects. The introduction in California of the fig-fertilising insect of South Europe has enabled a new industry in fig-growing to be started on promising lines in that State. Other parasitic insects of various scale pests and of the Gypsy and Brown tail moths, imported pests which have proved most harmful, have been introduced into the States with beneficial results. A systematic effort is also being made to introduce silk culture in the United States, Italian worms being imported.

The Year-book contains a large number of instructive, illustrated articles; photography is largely used to illustrate these, and in "New Fruit Productions of the Department of Agriculture," and "Promising New Fruits," coloured plates are a feature. We may note the following articles as of special interest—Diversified Farming in the Cotton Belt; Dark Fire-cured Tobacco of Virginia; The Business of Seed and Plant Introduction and Distribution; The Handling of Fruit for Transport; Effect of Inbreeding in Plants; Influence of Experiment Station Work on Culture of Field Crops; Relation of Irrigation to Dry Farming; and Opportunities in Sub-tropical Fruit-growing. The appendix of 200 pages has also numerous good articles. The whole Year-book is a splendid compilation, an example of the great progress in agriculture made in the past few years, and evidence of the work being done to encourage and assist the agriculturist in the United States; but, as the Secretary remarks in his report, "great as the work undertaken and accomplished has been, and gratifying as are the results, we are still at the threshold of agricultural development, and the educational work which has led to such grand results has only been extended as yet to a portion of our agricultural population."—I. E.

The Economic Resources of Uganda.—This is a report by M. T. Dawe, officer in charge, Forest and Scientific Department, Uganda, of a botanical mission through the forest districts of Buddu and the Western and Nile Provinces of the Uganda Protectorate. An interesting description is given of the country, the vegetation, the animals and the inhabitants of this hitherto little known region. The report pays particular attention to the general distribution of plants, and especially notes the distribution of *Funtumia elastica* and other important rubber plants, and of trees affording useful timber. An important result of the mission was the discovery of *Funtumia elastica* (or *Kickxia elastica*, as it used to be called), the Lagos silk rubber tree, which was not hitherto known to exist in Uganda, and its rubber had never been exploited by the natives. "Its discovery came, therefore, as a great boon to Uganda, seeing that at the present time rubber is of such great commercial importance, and the tree being indigenous no further proof was necessary to assure us of its suitability to our climate and soil." Three new species of Landolphias or rubber-yielding lianas were found—*Landolphia Dawei*, *L. subturbinata*, and *L. ugandensis*—and also one of the Clitandras (*C. orientalis*). These rubber plants are illustrated by plates of botanical drawings made at Kew by Miss M. Smith. Numbers of fine timber trees were also found, and a large collection of valuable timbers made. The greater part of the districts traversed was covered with dense forests and much swamp was found in parts, while the civilization of the natives is very limited and their agriculture of the most primitive description except in a few districts. As regards land suited to planting and agriculture from a European standpoint, the best is said to be in the Mboga and Bwamba countries along the Ruwenzori and Mboga ranges, up to 8,100 feet. "The lower slopes of this mountain range seem to be admirably adapted to the cultivation of tea; the soil is very rich, and I should imagine the rainfall to be here quite 100 inches per year. The whole of this country constitutes one of the finest and richest districts for the purposes of cultivation that I have seen within this Protectorate."

An interesting remark is made concerning the Acholi people, who domesticate the wild forest bee; making "long cylindrical hives about 4 to 5 feet in length and 12 to 18 inches in diameter, of bamboos, wattles, or bark, usually placed in low Ficus trees." A full list of plants collected during the mission is added.—I. E.

Memoirs of the Department of Agriculture in India.—Botanical Series. (Vol. I., Nos. 1, 2, 3,) issued from the Agricultural Research Institute, Pusa. No. 1, Studies in Root Parasitism, by C. A. Barber, Government Botanist, Madras, deals with the Haustorium of the Sandal Tree (*Santalum Album*), in its early stages, up to penetration; and other plants whose roots it attacks, illustrated by 7 plates. No. 2, Indian Wheat Rusts, by E. J. Butler, Imperial Mycologist, and J. M. Hayman, Deputy Director of Agriculture, U. P., with a note on the Relation of Weather to Rust on Cereals by W. H. Moreland, Director, Department of Lands and Agriculture, U. P., illustrated by coloured plates and diagrams. No. 3, Fungus Diseases of Sugar Cane in Bengal, by E. J. Butler, illustrated by coloured plates and diagrams,

Lift Irrigation.—Published by Messrs. Natesan & Co., Madras.—A useful little treatise on the subject of lift irrigation by Alfred Chatterton, with special reference to Southern India. The author advocates the use of oil engines and centri fugal pumps and the use of windmills. The supplies of water at a depth in part of South India have been found to be very satisfactory, and some fifty oil engines are already at work and have resulted in profitable agriculture. Oil engines, even on a small scale it is stated, are much less costly than bullock power. The following are some of the subjects treated—Development of lift irrigation; value of windmills for irrigation in India and America; well irrigation; and irrigation by pumping in the United States.—I. E.

The Ceylon Board of Agriculture.

The Twenty-second Meeting of the Board of Agriculture was held at Queen's House on Monday, August 6th, 1906, at 2-30 p.m.

His Excellency the Governor presided.

There were present the Hon. Mr. H. L. Crawford, C.M.G., Sir William Twynam, K.C.M.G., the Hon. Mr. C. T. D. Vigors, the Hon. Mr. S. C. Obeyesekere, the Hon. Mr. Francis Beven, Messrs. L. W. Booth, J. P Lewis, E. F. Hopkins, R. W. Smith, R. B. Strickland, Dr. J. C. Willis, Messrs. E. E. Green, M. Kelway Bamber, C. Drieberg, G. W. Sturgess, the Maha Mudaliyar, Dr. H. M. Fernando, Messrs. E. B. Denham, W. Dunuwille, W. D. Gibbon, R. Morison, A. T. Rettie, G. A. Joseph, and the Secretary.

Visitors:—Messrs. J. H. W. Park, M. Suppramaniam, J. Whitehead, and S. Weerackkody Mudaliyar.

Business Done.

1. Minutes of last meeting were read and confirmed.
2. List of new members was read, and they were declared duly elected.
3. Progress Report No. 21 was tabled.

4. A paper was read by Mr. J. H. W. Park, Assistant Director of Irrigation, on the subject of "Irrigation in Arizona." A discussion followed, in which H. E. the Governor, Dr. Willis, Messrs. Hopkins, Smith and others took part.

5. The report of the Special Committee appointed at the last meeting of the Board, suggesting certain amendments in the draft of the proposed Ordinance dealing with the destruction of Agricultural Pests and the Sanitation of Plants, was submitted. After a brief discussion the report was adopted.

6. Copy of a resolution conveying the thanks of the North Arcot District Agricultural Association to the Ceylon Agricultural Society for the assistance and information given to their Asst. Secretary, Mr. Sreenivasa Raghava Aiyar, on the occasion of his visit to Ceylon in May last, was laid before the meeting.

7. A leaflet was read by Mr. E. E. Green, Government Entomologist, containing suggestions put forward by himself and the Government Chemist, Mr. M. K. Bamber, as to the possibility of preventing the spread of malaria through the agency of the "anopheles" mosquito by the use of an application composed of citronella, kerosine and coconut oils with a certain proportion of carbolic acid. Mr. Bamber submitted a sample of the preparation. A discussion followed, in which H. E. the Governor, Dr. Willis, Dr. H. M. Fernando and others took part.

8. An application from Mr. Drieberg, Superintendent of School Gardens, for a vote of Rs. 100 to meet the cost of a stocked hive of imported bees and to continue the experiment in apiculture was considered. Resolved that the sum asked for be voted.

9. On the suggestion of H. E. the Governor it was resolved that an exhibit representative of native arts and crafts should be shown under the auspices of the Ceylon Agricultural Society at the forthcoming Rubber Exhibition at Peradeniya.

His Excellency desired the Secretary to communicate with the Government Agents and local agricultural societies with a view to securing as representative a collection as possible.

10. Samples of Sea Island and Caravonica cotton grown in the Matale district by Mr. A. H. Don Bastian de Silva, and sent in by the Hon. Secretary of the Matale Agricultural Society, were laid on the table.

Agricultural Society Progress Report. XXII.

The membership of the Ceylon Agricultural Society is now 1,120.

1. *Agri-Horticultural Shows.*—I was present, by invitation of the Government Agent, North-Western Province, at the *Kurunegala Agri-Horticultural Show* held on the 23rd to 25th August. The show, which was the first of the kind ever held in the North-Western Province, was on all sides considered to be an unqualified success. It had twice been postponed owing to the unusual drought, but in spite of the continuance of the drought up to a short time before the show the exhibition of fruits and vegetables, &c., was remarkably good, while the classes for live stock were exceptionally well filled. His Excellency the Governor visited the show on the opening day. The reports of the scientific officers of the Society on the sections judged by them are tabled.

On the 7th and 8th August I was present at the *Kelani Valley Agri-Horticultural Show.* The show was held on the grounds of the Kelani Valley Club at Talduwa, and was opened by the Hon. Mr. H. L. Crawford, Government Agent, Western Province. Like that at Kurunegala, the Kelani Valley Show was the first of its kind ever held in the district, and, although it fell short of the former as regards the number and variety of exhibits of village produce, the classes for estate products, such as tea and rubber, were very well filled, as was also the poultry section.

The success of both these shows was most encouraging, and much credit is due to the Honorary Secretaries, Mr. A. W. Seymour, C.C.S., at Kurunegala, and Messrs. J. W. Bamforth and C. J. A. Marshall at Talduwa, for the trouble taken by them to ensure a successful exhibition. It is to be hoped that both shows will become annual fixtures.

The *Kegalla Agri-Horticultural Show* will be held on the 21st and 22nd September.

It is proposed to hold a show of fruits and vegetables towards the end of September at *Telijjawila.*

At a meeting of the Telijjawila Local Society held on the 6th July it was decided to hold a show of agricultural and industrial products of Weligam Korale on the 15th March, 1907, at *Weligama.* It was further agreed to give a prize of Rs. 50 for the best vegetable garden *in crop* in the next planting season, which will be at the end of the year, and three prizes of Rs. 50, as at the previous show, for the best results shown by transplanting of paddy in the ensuing *yala* harvest. It was also agreed to include a class for cattle (milch cows or best-fed bulls) at this show.

Further shows will be held at the following centres as under:—

Three Korales and Lower Bulatgama (Market Show) ...	October 21.
Wellaboda Pattu (Galle)	November 16 and 17.
Batticaloa	Early in 1907.

At a meeting of the Three Korales and Lower Bulatgama Branch held on the 21st July it was agreed to increase the number of prizes offered from 12 to 26. Nine of the prizes are of Rs. 10 each, the rest being Rs. 5 each. Among the donors are Messrs. W. Forsythe, W. J. Smith, R. I. Mackenize, several headmen, and local merchants.

2. *Experimental Garden, Ratnapura.*—The Committee appointed at the last meeting of the Ratnapura Branch have suggested two or three sites for opening the proposed experimental garden in the town of Ratnapura, but no definite selection has yet been made. It is expected that the matter will be definitely settled at the next meeting.

3. *Yams.*—Mr. A. E. Rajapakse, Chairman of the Katunayaka Branch, reports as follows:—"Besides cassava, there is another kind of yam which would be very useful to poor people if introduced to places where it is not found. This is a kind of sweet potato largely grown in the Southern Province. There are varieties of it—yams that could be lifted in two months, three months, and six months, &c. The early varieties are very successfully grown in paddy fields, after the paddy has been harvested." Mr. Rajapakse will be glad to supply these yams to any one willing to experiment with them free of cost.

4. *Manure for Experiment.*—Messrs. Freudenberg & Co. have supplied to the Local Branch at Gampola 22 cwt. of manure for purposes of experiment with paddy.

5. *Date Palm Suckers.*—Mr. V. Casipillai of Jaffna reports under date the 15th August that all but two of the date palm suckers supplied to him have died, and that the two suckers that have so far survived have not yet begun to grow, though they are well looked after. Mr. Casipillai has promised to report further on the growth of the two remaining suckers.

6. *Lemon Grass Rootlets.*—Mr. B. Samaraweera of Weligama reports that he has a quantity of these for sale. Rootlets can be obtained on application direct to Mr. Samaraweera.

7. *Prickly Pear, Extermination of.*—The Government Agent, Northern Province, Jaffna, has sent the following report from the President, Delft Gansabhawa, on the result of the experiment in exterminating this pest:—"I have the honour to report that I tried the solution of sodium arsenic on a bush of prickly pear in front of my bungalow on the 28th ultimo, and the effects have been simply surprising. Within twenty-four hours the leaves turned brown, and the second day the whole bush looked burnt and dry. The experiment has proved a success, and the villagers are very anxious to have this plant fully removed from the Island, and I shall get the Village Committee to vote the necessary funds for obtaining the solution in large quantities and the necessary implements required for the purpose as directed."

8. *Seed Paddy from India.*—The Thasildar of Tanjore, who was asked to obtain for the Society a supply of *Muttusamba* paddy, states that he was able to procure only a small quantity, and that even the amount collected is now reported to be unfit for seed. He regrets that under the circumstances *Muttusamba* paddy cannot be despatched this year.

9. *Six-Months and Five-Months Seed Paddy from India—Samba Varieties.*—Two consignments of six-months and five-months seed paddy from India, consisting of nearly 700 bushels, were received early in August. This paddy consists of three varieties:—

(*a*) Small grains containing round and white rice (five months).
(*b*) Long white grains containing white rice (five months).
(*c*) Long red grains containing white rice (six months).

Some of this paddy has been supplied to Vavuniya, Gampola, Badulla, Puttalam, Kegalla, Kurunegala, Kandy, Nawalapitiya, Nuwara Eliya, Balangoda, Matale, Angammana, Katunayake, and Katana.

Supplies of these paddies are still available, and application for them should be made direct to the Director, Royal Botanic Gardens, Peradeniya. The cost of the seed paddy is Rs. 2·75 per pushel.

10. *Banku Paddy from India.*—The supply of Banku Paddy received from India (a four-and-a-half months variety) has been fully booked among the following districts:—Kurunegala, Jaffna, Kandy, Balangoda, Gampola, Mullaittivu, Colombo, Welimada, and Badulla.

11. *Three-Months Paddy (Local).*—Ten bushels of three-months seed paddy were supplied by the Matale Local Branch to the Anuradhapura Local Society on the application of Nikawewa Dissawa, who sowed eight bushels himself and gave two bushels to Mr. Sampander (Proctor, Anuradhapura). Nikawewa Disawa reports that he realized a crop of 78 bushels. He writes that he could have obtained a better crop but for the harm done by flies, owing to the paddy being sown out of the proper season. "The paddy does not appear to do well in very muddy lands, but thrives exceedingly well in moderately muddy places."

12. *Kiushu Paddy.*—The Mudaliyar, Wellaboda Pattu (Galle), Hikkaduwa, reports:—"The paddy was sown on different sorts of lands and at different dates, with all possible care as to preparation of ground, but the result in every case was unsatisfactory."

Mr. C. A. Valoopillay of Anuradhapura reports:—"I bought from the Chairman of the Anuradhapura Branch one bushel of Kiushu paddy and sowed the same on the 31st March last on a well-prepared clayey soil by the side of a waste water channel, from which I was able to turn water in and out so as to suit the requirements of plants. It germinated at the same time as other varieties under the wet method, and the plants appeared healthy but shorter in height. Weeding and transplanting were started after the thirty-fifth day as usual; but I had to suspend weeding as the plants had begun blossoming. The plants did not grow more than two feet in height, but the yield was 35 bushels, and it may be fifty-fold and even more if properly weeded. I am now making a second trial in the same fields and will submit a report in course of time. I have about 30 bushels of seed paddy of this variety, and have given away about five bushels in this Province and in Jaffna to be sown and tried. I can state with confidence that this paddy is a success in my fields. Further experiments in rich soil or under good manure and careful cultivation may reveal better results. I am also of opinion that this paddy serves better to compensate in times of scarcity of water, as it could be reaped in seventy-five days. In this trial the sowing was done on 31st March, 1906, and reaped on 23rd June, thus taking eighty-five days in all. I am of opinion that this paddy is suitable to this country."

In continuation of the previous report published in Progress Report No. XXI., the Honorary Secretary of the Badulla Branch writes:—"The owner of the field in question sowed one bushel of Kiushu paddy; when harvested this seed brought in half a bushel of produce. In the same field he sowed native paddy, and this brought in on an average 6½ bushels of paddy."

The Secretary, Wellaboda Pattu (Galle) Local Society, reports under date the 17th August that, though tried in different ways and in different soils, the Kiushu paddy did not thrive. The opinion of the members of his Society is that it is unsuited to that part of the Island.

The Secretary of the Local Branch at Hambantota reports that the paddy was sown on land irrigated by Tissa tank, but the cultivation failed for want of sufficient water.

13. *Cotton Seed.*—It is proposed to introduce a series of experiments with cotton as a chena crop. Special chena permits are being issued in the Mullaittivu District and in the Wanni Hatpattu of the Kurunegala District, one condition of which is that each permit holder shall sow a certain extent of land with cotton. I had the advantage during my recent visit to Kurunegala of discussing the subject with Hulugalle Disawa, under whose personal supervision I am confident that the

experiment will be given every chance of success. I am now making arrangements for a supply of seed for experimental purposes in the following localities:—

North-Western Province for	... 250 acres	(for chena cultivation)
Mullaittivu ...	... 120 ,,	(for chena cultivation)
Jaffna	... 20	
Delft	... 5	
Batticaloa ...	... 20	

14. *Rotation of Chena Crops.*—Other experiments are proposed as regards chena cultivation in the Mullaittivu and Kurunegala Districts.

The following rotation of chena crops has been suggested by the Director, Royal Botanic Gardens, for experiment in Kurunegala:—Cotton, Tapioca (*i.e.*, Cassava), Dry Grains, and Ground Nuts.

These experiments should prove of interest to chena cultivators in all parts of the Island, their object being to prove whether it is not possible by the adoption of a scientific rotation of crops to overcome the necessity for allowing chena lands to lie fallow for ten or twenty years at a time, as is at present done in most parts of the country.

15. *Vegetable Seeds.*—A further supply of vegetable seeds is to be imported by the Society shortly.

16. *Castration of Cattle.*—Since the last report three demonstrations have been given in the Southern Province, namely, at Ganegama, Wanduramba, and Nagoda. Eight demonstrations have been held in the North-Western Province, at Nawagategama, Ihalapitiya, Kulama, Mampuri, Nachchikalli, Kalpitiya, Moheriya, Kattakadu, and Pallaure. Twelve in the North-Central Province: at Toruwewe, Karawilagala, Gantiriyagama, Halambawe, Galkiriyagama, Balaluwewa, Unduruwe, Kadawatgama, Etakade, Kallanchiya, Tambalagollewa, and Rambewa. Twelve demonstrations are in the course of arrangement in the North-Western Province.

To date the figures are 2,293 cattle castrated, belonging to 1,872 owners, at 113 demonstrations 122 men have been taught the operation.

17. *Castration Work by locally trained Men.*—The following are details of work done by the men trained at local centres:—

Hambantota 10 animals castrated, Lower Dumbara 13, Matara 99 (in 1905), Panadura 40, Delft 24, Kandy District (Harispattu 6, Pata Dumbara 13) 19; in Wellaboda pattu (Galle) the locally trained men are reported to be carrying on work. Owing to want of instruments and medicines no operations have been carried out by the trained men in Mullaittivu, Three Korales and Lower Bulatgama, Chilaw, Talangama, Mannar, and Anuradhapura. Arrangements are being made to supply the necessary instruments and drugs. The Jaffna Branch, Delft Gansabhawa, and the Village Committees of the Central Province have supplied instruments and medicines to the men in those districts. Two men trained in the new method on Horrekelly estate are doing work there.

18. In accordance with the resolution passed at the last meeting of the Board, arrangements were made to hold an *Exhibition of Native Arts and Crafts* in connection with the Ceylon Rubber Exhibition at Peradeniya. Dr. A. K. Coomaraswamy very kindly undertook to arrange for a representative exhibition of the manufactures of the different parts of the Island. A special pavilion has been erected for the Society on the Exhibition Grounds, while in addition four small tents have been set apart for its use. Some seventeen parties of workmen have been engaged, who are now giving daily demonstrations of their art. These include weavers and brassfounders from Batticaloa, a painter from Jaffna, a cloth dyer from Mannar, lace makers from near Colombo, workers in silver, brass, ivory, lacquer-

work, and iron damascening, potters, ironfounders, and weavers from the Central Province. A large number of exhibits of weaving, basket making, brass work ivory work, &c., &c., are on view.

Copies of a Handbook dealing with the Arts and Crafts of Ceylon, by Dr, Coomaraswamy, are available at the Exhibition.

19. In addition to the above, special exhibits of various products have been got together. Mr. M. K. Bamber has kindly arranged a representative exhibit of coconut products and tobacco; Mr. C. Drieberg of oils, fibres and tanning, and dyeing stuffs; Mr. E. E. Green of silk and silkworms from the Government Silk Farm. Mr. A. E. Rajapakse, Muhandiram, has sent in samples of cinnamon from Negombo District, and Mr. J. W. C. de Soysa and Dr. H. M. Fernando samples of cotton from Kurunegala. Mr. J. Whitehead is giving an exhibition of cotton ginning and dyeing, while Mr. M. K. Bamber is giving a demonstration in the distillation of camphor.

The Dumbara, Telijjawila, Kandaboda pattu, Wellabopa pattu (Galle.) Vavuniya, and Jaffna Agricultural Societies have sent in representative collections of native products and manufactures.

The exhibition made on behalf of the Society is in every way a valuable and interesting one, and the thanks of the Society are due to the gentlemen who have been good enough to lend their assistance in arranging for the different exhibits.

A. N. GALBRAITH,

Secretary, Ceylon Agricultural Society.

September 17, 1906.